

PROPOSED

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)
BACKGROUND DOCUMENT
FOR
SPENT ALUMINUM POTLINERS – K088

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EXECUTIVE SUMMARY

This background document provides the U.S. Environmental Protection Agency's (EPA's) rationale and technical support for developing revised Land Disposal Restriction (LDR) treatment standards for K088. EPA defines K088 as spent potliners from primary aluminum reduction.

EPA prohibited the land disposal of both nonwastewater and wastewater forms of Hazardous Waste K088 in the Phase III Land Disposal Restrictions Rule (61 FR 15566, April 8, 1996). In that rule, the Agency established concentration-based limits for 25 constituents in nonwastewater and wastewater forms of K088. Subsequent to the publication of the final rule, petitions for judicial review of the Phase III rule were filed with the U.S. Court of Appeals for the District of Columbia. In an April 3, 1998 decision, the Court ruled that EPA's use of the Toxicity Characteristic Leaching Procedure (TCLP) as a basis for setting treatment standards was arbitrary and capricious for those constituents for which the TCLP demonstratively and significantly underpredicted the amount of the constituent that would leach.¹ While this language applied only to fluoride and arsenic, the Court vacated all of the treatment standards established for K088 in the Phase III rule. Issuance of the Court's decision was to be delayed, until September 24, 1998, in response to an Agency motion. On September 24, 1998, EPA published the land disposal prohibition and treatment standards for wastewater and nonwastewater forms of K088 (63 FR 51254), including a revised, interim treatment standard for arsenic in nonwastewater forms of K088 and deferral of revised fluoride standards. In that interim final rule, the Agency announced its long-term goal of promulgating a revised set of treatment standards for K088 based on the performance of a treatment technology that results in the immobilization of arsenic and fluoride, as well as the other toxic metals in the waste.

This background document supports EPA's current task, as outlined in the September 24, 1998 final rule, of proposing revised waste-specific LDR treatment standards for nonwastewater forms of K088, specifically, fluoride and two forms of cyanide. Compliance with these standards will be based on the concentrations of total cyanide, amenable cyanide, and the leachable

¹EPA's interpretation of the Court's opinion. See 139 F.3d 914.

concentration of fluoride in the waste as measured by a version of the TCLP that uses deionized water as the leaching fluid (ASTM Method D3987–85 (1999)). The Agency is deferring further action of a revised arsenic standard to replace the interim standard at this time pending completion of additional research. Treatment standards for arsenic and the remaining 22 constituents in wastewater and nonwastewater forms of K088 wastes remain in effect, as promulgated in the September 24, 1998 rule, and must be complied with before land disposal. These standards, along with the proposed treatment standards for amenable cyanide, total cyanide, and fluoride, are also highlighted in Table ES–1.

In developing the LDR treatment standards presented in this document, EPA initially focused only on three constituents in K088 wastes—arsenic, fluoride and cyanide. Additional constituents, including PAHs and other metals, are regulated constituents in K088 and were not subject to the Agency’s re-evaluation. EPA subsequently is proposing treatment standards for fluoride and cyanide. However, because the proposed treatment standards are developed from a technology different than the one used in developing the current treatment standards, EPA evaluated whether this treatment technology would generate residuals that would also meet these existing treatment standards.

The treatment standards for fluoride and cyanide are based on performance data for a full-scale combustion melting system process in operation at Ormet Corporation, Hannibal, Ohio², and were developed consistent with existing EPA procedures detailed in *Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance, Quality Control Procedures, and Methodologies*, October, 1991 (1).

For the convenience of the reader, Table ES–1 presents a full listing of the constituents of concern and their corresponding treatment standards. The proposed revisions for fluoride and cyanide appear at the beginning of Table ES–1.

²After analyzing and evaluating technical performance data of full-scale treatment facilities, the Agency determined Ormet’s process to be BDAT for the treatment of fluoride and cyanide. The BDAT process at Ormet also can produce a treatment residual with concentrations of the remaining 23 hazardous constituents, including arsenic, that meet treatment standards of nonwastewater forms of K088.

Table ES–1. Summary of Existing Treatment Standards and Proposed Numerical Treatment Standards for Selected Constituents in Spent Aluminum Potliner — K088

Constituent of Concern	Proposed Numerical Standard ^a (40 CFR §268)	
	WW (mg/L)	NWW
Fluoride	—	2.7 mg/L ^b
Cyanide	—	1.4 mg/kg ^c
Cyanide (amenable)	—	1.4 mg/kg ^c
	Existing Numerical Standard (40 CFR §268)	
	WW (mg/L)	NWW (mg/kg) or noted as mg/L TCLP ^d
Acenaphthene	0.059	3.4
Anthracene	0.059	3.4
Benz(a)anthracene	0.059	3.4
Benzo(a)pyrene	0.061	3.4
Benzo(b)fluoranthene	0.11	6.8
Benzo(k)fluoranthene	0.11	6.8
Benzo(g,h,i)perylene	0.0055	1.8
Chrysene	0.059	3.4
Dibenz(a,h) anthracene	0.055	8.2
Fluoranthene	0.068	3.4
Indeno(1,2,3-cd)pyrene	0.0055	3.4
Phenanthrene	0.059	5.6
Pyrene	0.067	8.2
Antimony ^e	1.9	1.15 mg/L TCLP
Arsenic	1.4	26.1
Barium ^e	1.2	21.0 mg/L TCLP
Beryllium ^e	0.82	1.22 mg/L TCLP
Cadmium ^e	0.69	0.11 mg/L TCLP
Chromium (total)	2.77	0.60 mg/L TCLP
Cyanide (total)	1.2	590 ^a
Cyanide (amenable)	0.86	30 ^a
Fluoride	35	—
Lead ^e	0.69	0.75 mg/L TCLP
Mercury ^e	0.15	0.025 mg/L TCLP
Nickel ^e	3.98	11.0 mg/L TCLP
Selenium ^e	0.82	5.7 mg/L TCLP
Silver ^e	0.43	0.14 mg/L TCLP

^a The numerical treatment standards for nonwastewater forms of total cyanide and amenable cyanide found in K088 wastes are currently published in 40 CFR §268 as: total cyanide - 590 mg/kg, and amenable cyanide - 30 mg/kg.

^b The previous treatment standard for fluoride was 48 mg/L TCLP. The proposed fluoride treatment standard presented is based on a total fluoride analysis of the TCLP leaching procedure using distilled water as the leaching fluid (ASTM Method D3987–85 (1999)). Fluoride analysis may be performed according to SW–846 Method 9056. No preparation of the sample extract should be necessary.

^c The proposed cyanide treatment standards presented are based on total and amenable analyses. These analyses may be performed according to SW–846 Method 9010 or 9012. The methods must be followed, as written, for liquid samples. For solid samples, an additional note is presented in 40 CFR 268.40, footnote 7 of the Treatment Standard Table.

^d TCLP refers to the Toxicity Characteristic Leaching Procedure, SW–846 Method 1311.

^e The nonwastewater numerical standards included here were revised in May 1998 by EPA as Universal Treatment Standards (UTS). The listed UTS apply to nonwastewater forms of any listed or characteristic hazardous waste required for land disposal. (63 FR 28556, May 26, 1998.)

1.0 INTRODUCTION

This background document presents calculations for revised treatment standards for nonwastewater forms of spent potliners from primary aluminum reduction (K088 waste). Specifically, the U.S. Environmental Protection Agency (EPA) is proposing revised, concentration-based treatment standards for amenable cyanide, total cyanide, and fluoride under its Land Disposal Restrictions (LDR) program. The Agency is proposing these treatment standards as part of its long-term goal of promulgating a revised set of treatment standards for K088.

Section 3004(m) of the Resource Conservation and Recovery Act (RCRA) of 1976 enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984 specifies that treatment standards must minimize long- and short-term threats to human health and the environment arising from land disposal of hazardous wastes. EPA's treatment standards for individual wastes are presented at Title 40 *Code of Federal Regulations* Section 268.40 (40 CFR 268.40). For a given waste, a treatment standard specifies (1) the concentration of each constituent in total or Toxicity Characteristic Leaching Procedure (TCLP) analysis or (2) a technology which must be used for treating the waste. EPA establishes treatment standards for wastewaters and nonwastewaters, as well as any subgroups which may be appropriate. Compliance with treatment standards is a prerequisite for land disposal, as defined in 40 CFR Part 268. In 40 CFR 268.44 and 268.6, respectively, EPA supplies provisions, that, if met, may justify granting a variance or waste- and site-specific waivers from the applicable treatment standards in 268.40.

EPA's general approach for complying with the requirements, as outlined in HSWA, was promulgated as part of the November 7, 1986 Solvents and Dioxins rule. EPA has, however, established the treatment standards presented in this document according to its guidance in the *Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance, Quality Control Procedures, and Methodologies*, October 1991 (1).

1.1 Regulatory Background

EPA finalized the land disposal of both nonwastewater and wastewater forms of K088 in the Phase III Land Disposal Restriction rule (61 FR 15566, April 8, 1996). The Phase III LDR prohibited the land disposal of spent potliner unless the waste satisfied the section 3004(m) treatment standard established in the same rulemaking. The Phase III rule also established concentration-based treatment standards for various constituents in both wastewater and nonwastewater forms of K088. These 25 constituents, included arsenic, cyanide, fluoride, toxic metals, and a group of organic compounds called polycyclic aromatic hydrocarbons (PAHs).

With one exception, the treatment standard limits established for K088 were equivalent to the universal treatment standards in 40 CFR 268.48. The fluoride standard, however, was based generally on data submitted in a delisting petition from the Reynolds Metal Company. During a nine-month national capacity variance pursuant to Section 3004(h)(20), where the Agency allowed facilities generating K088 adequate time to work out logistics (61 FR 15589, April 8, 1996), unexpected performance problems in the Reynolds treatment process resulted in the generation of leachate exhibiting characteristics of hazardous waste.³ The company was also disposing of the treatment residues in non-subtitle C units. EPA therefore felt that further time was needed to evaluate whether adequate protective treatment capacity was available and, as part of this determination, whether Reynolds' practices in fact satisfied the mandate of Section 3004(m) that threats posed by land disposal of the hazardous waste be minimized through treatment. Until these questions were answered, and a finding of sufficient protective treatment capacity was made, there was insufficient treatment capacity for the waste because Reynolds, at the time, was the only existing commercial treatment facility for spent potliners. Consequently, on January 14, 1997 (62 FR 1992), the Agency extended the national capacity variance and postponed implementing the land disposal prohibition for an additional six months to be able to study the efficacy of the Reynolds treatment process and the resulting leachate.

³It was discovered that the Reynolds treatment process produced residues having actual leachate that contained higher concentrations of arsenic and fluoride than the concentrations predicted by the Toxicity Characteristic Leaching Procedure (TCLP). Also, arsenic and fluoride were significantly more soluble in highly alkaline conditions (the disposal environment of the landfill used by Reynolds) than acidic conditions (the modeled environment predicted by the TCLP)(62 FR 1992, January 14, 1997).

In July 1997 (62 FR 37696), EPA announced that, “Reynolds’ treatment (albeit imperfect) does reduce the overall toxicity associated with the waste,” that disposal of treatment residues would occur only in units meeting Subtitle C standards, and consequently, treatment was an improvement over the disposal of untreated spent potliner and provided adequate protective treatment capacity. On October 8, 1997, the national capacity extension ended, and the prohibition on land disposal of untreated spent potliner took effect.

Subsequent to the publication of the Phase III rule, the January 1997 extension, and the July 1997 rule, petitions for judicial review were filed with the U.S. Court of Appeals for the District of Columbia. The petitioners, namely Columbia Falls Aluminum Company and other aluminum producers from the Pacific Northwest, argued (among other things) that use of the Toxicity Characteristic Leaching Procedure (TCLP) did not accurately predict the leaching of waste constituents, particularly arsenic and fluoride, to the environment and that it was, therefore, arbitrary to measure compliance with the treatment standard using this test. The U.S. Court of Appeals for the District of Columbia decided on April 3, 1998 that EPA’s use of the TCLP as a basis for measuring concentrations for treatment standard calculations of K088 waste was arbitrary and capricious for those constituents for which the TCLP demonstratively and significantly underpredicted the amount of the constituent that would leach (138 F.3d 914). With this language only applied to arsenic and fluoride in nonwastewater forms of K088, only 2 of 54 treatment standards were implicated; however, the Court vacated all of the treatment standards established for K088 in the Phase III rule and the prohibition on land disposal.

In response to the April 3, 1998 Court decision, EPA filed a motion with the Court on May 18, 1998 to delay issuance of its mandate for four months while the Agency promulgated a replacement prohibition and accompanying treatment standards. The Court granted this motion, indicating that its mandate would not issue before September 24, 1998.

Shortly thereafter, on September 24, 1998, the Agency published a final rule prohibiting the land disposal of K088 and promulgated interim replacement standards for K088, pending the completion of a review of all information on treatment processes that could serve as a basis for permanent, revised standards. (63 FR 51254, September 24, 1998.) The Agency reinstated the previously vacated standards for the 52 wastewater and nonwastewater treatment standards for which compliance was not measured through the use of the TCLP. For arsenic in nonwastewater forms of K088, the Agency promulgated a concentration-based numerical standard of 26.1 mg/kg, based on total arsenic concentrations. The concentration-based, numerical standard was determined from data sets submitted to the Agency identified in a Notice of Data Availability (NODA).⁴ (63 FR 41536, August 4, 1998). For fluoride, the Agency elected not to develop an interim standard in nonwastewater K088, but to defer action until additional research and analysis could be completed. Refer to Appendix A for more information regarding the regulatory history affecting K088 treatment standard development, and Appendices B and C for additional information regarding the August 4, 1998 NODA and the September 24, 1998 final rule, respectively.

1.2 Summary

This background document presents calculations for revised treatment standards for fluoride, total cyanide, and amenable cyanide in K088 waste. A revised treatment standard for fluoride is calculated to be 2.7 mg/L, based on concentrations measured by a version of the TCLP that uses deionized water as the leaching fluid (ASTM Method D3987–85 (1999)). The proposed treatment standards for total cyanide and amenable cyanide, 1.4 mg/kg and 1.4 mg/kg, respectively, were based on analysis performed according to SW–846 Method 9010. Although treatment standards were promulgated for total and amenable cyanide in the September 24, 1998 rule, EPA found that the cyanide present in K088 waste can be treated to levels far below the current treatment standard and has maintained its objective of controlling the release of high

⁴The August 4, 1998 NODA (63 FR 41536) issued by the Agency identified four data sets as possible data sets from which a total arsenic standard could be developed. Two of the data sets represented full-scale data from the treatment of K088 at the Reynolds Metal Company treatment facility. The other two data sets represented pilot-scale data from a combustion melting system process at the Ormet Corporation treatment facility. The arsenic treatment standard was calculated using one of the Reynolds data sets.

concentrations of cyanide by developing these revised, concentration-based treatment standards.

After comparing full-scale treatment technologies within the aluminum industry, namely, treatment processes at Reynolds Metal Company in Gum Springs, Arkansas, Chemical Waste Management of the Northwest (CWMNW) in Gilliam County, Oregon,⁵ and Ormet Corporation in Hannibal, Ohio, the Agency determined Ormet's combustion melting system process as BDAT and calculated the treatment standards presented within this document based on concentrations of treated, spent potliner samples taken from this process. The Ormet process is a direct-fired vitrification system that provides highly effective treatment of cyanide, along with organic compounds contained in the K088 waste and effectively recovers the fluoride in the form of dust for reuse material. Specifically, a baghouse dust is produced from the treatment process and is fluoride-rich material which can be recycled back into the aluminum process or can be used by other industrial sectors. Also, Ormet's process effectively immobilizes the residual fluoride in the treated potliner in a glass-like matrix or "frit" and meets all treatment standards for regulated constituents in K088 nonwastewaters. Samples of the untreated spent potliner, treated glass residue, and baghouse dust were collected on June 15, 1999 and analyzed using methodologies outlined in Appendix I.

⁵Although the Agency reviewed treatment processes at CWMNW, performance data submitted by the facility was labeled as Confidential Business Information (CBI) and, therefore, was not presented in this Background Document.

2.0 DESCRIPTION OF SPENT ALUMINUM POTLINERS

This section describes the industry generating Hazardous Waste Number K088, the facilities generating these wastes, the processes generating the waste, the physical and chemical characteristics of this waste, and waste management practices handling these wastes.

2.1 Description of the Aluminum Production Industry

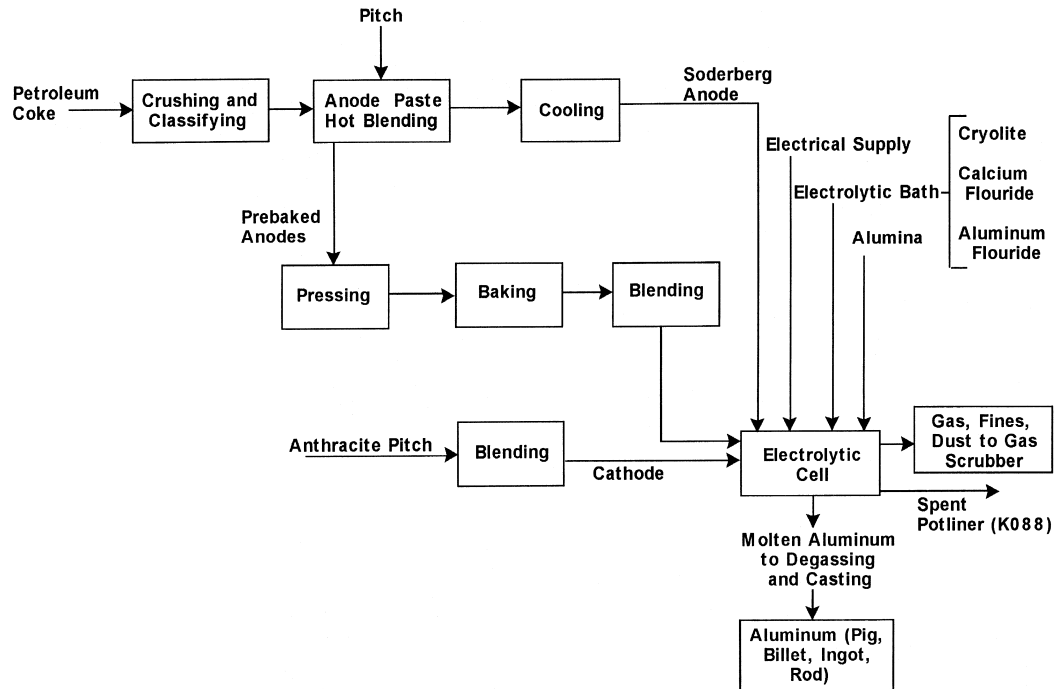
2.1.1 Description of Aluminum Reduction Process

Aluminum reduction facilities are classified by the U.S. Office of Management and Budget under Standard Industrial Classification (SIC) code 3334, which is under major heading 33, primary metal industries (4).

The production of aluminum occurs in four distinct steps: (1) the mining of bauxite ores, (2) the refining of bauxite to produce alumina (Al_2O_3), (3) the reduction of alumina to aluminum metal, and (4) casting of the molten aluminum. Spent potliner (K088) is generated from Step (3), so only that portion of the process will be described. Figure 2–1 provides a simplified process flow diagram of the aluminum reduction process. The diagram shows the location of the generation of the spent potliner in the process.

All primary aluminum produced in the United States is manufactured by the Hall-Heroult process using alumina as a raw material. Aluminum is refined by dissolving alumina (aluminum oxide) in a molten cryolite (Na_3AlF_6) bath. An electric current is then introduced reducing the alumina to aluminum. The reduction process requires high purity aluminum oxide, carbon, and electrical power and takes place in carbon-lined, steel electrolytic Hall cells, or “pots.”

Figure 2–1. Schematic of the Aluminum Process



Reference: U.S. EPA, Office of Water, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Primary Aluminum Smelting Subcategory of Aluminum Segment of the Nonferrous Metals Manufacturing Point Source Category, 1974 (5).

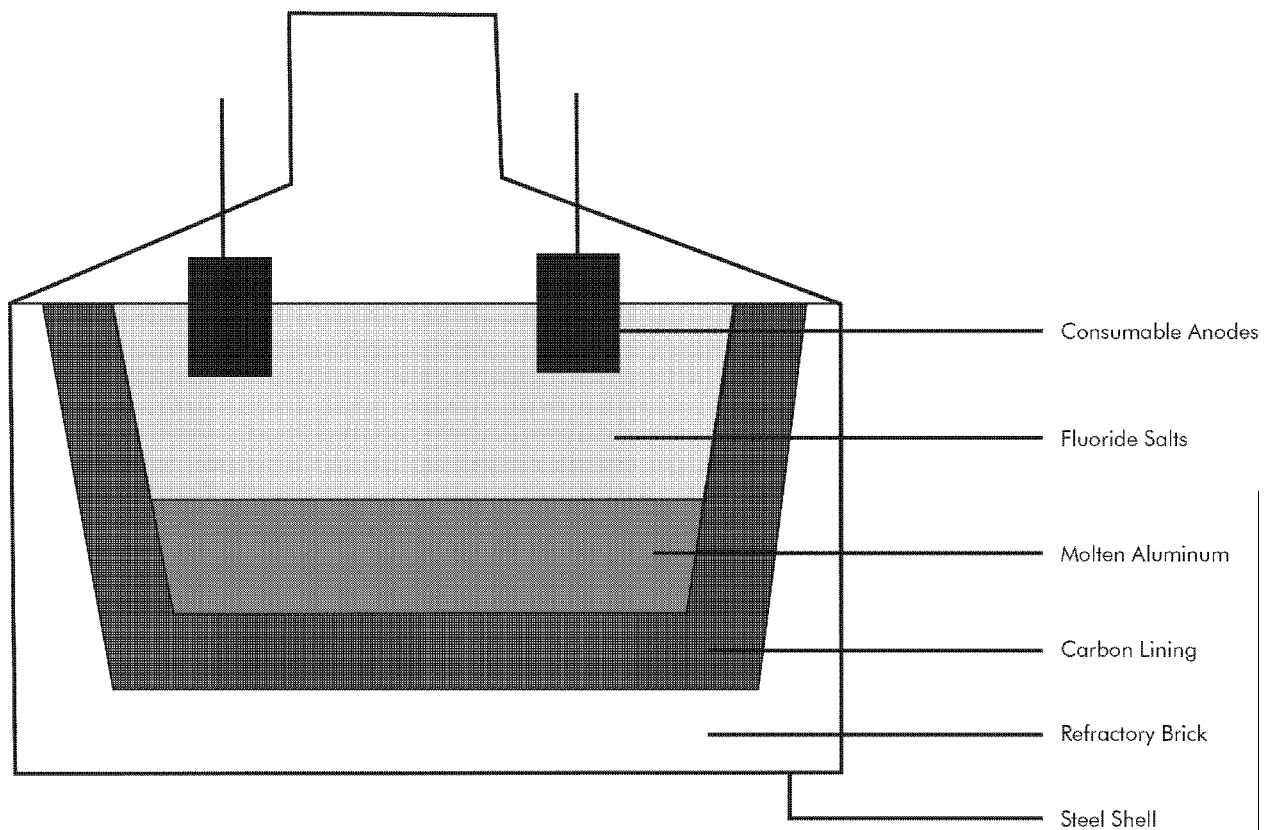
Pots consist of a steel container lined with refractory brick with an inner lining of carbon. The size of a pot ranges from 6x18 to 14x42 feet (5). Figure 2–2 shows a general sketch of a typical pot. These pots are electrically connected in series to form a potliner, which may contain from 100 to 300 reduction cells. Incoming, alternating current is transformed directly to direct current (DC) at high voltages and is fed to the line of pots. In this way, the operation is essentially at constant current, but the individual voltages can be varied on each pot. The DC supplied is on the order of several hundred volts and 60,000 to 100,000 amps. The carbon liner is usually up to 15 inches thick and serves as the cathode in the electrolytic circuit transforming aluminum ions from the molten bath to molten aluminum. The electrolysis takes place in a molten bath generally composed of the following materials:

Cryolite (Na_3AlF_6)	80 to 85%
Calcium fluoride (CaF_2)	5 to 7%
Aluminum fluoride (AlF_3)	5 to 7%
Alumina (Al_2O_3)	2 to 8%

The function of the electrolyte is to enable physical separation between the cathodically produced aluminum and the anodically evolved oxides of carbon while also enabling electrolytic decomposition of the alumina. The essential ingredient of the electrolyte is cryolite, or sodium aluminum fluoride (Na_3AlF_6). The pure white or colorless mineral is used principally because it is the best flux for alumina. Various additions to the cryolite modify its physical and chemical properties and, thus, improve cell performance. Aluminum fluoride and calcium fluoride are used to lower the melting point of the electrolyte.

The composition of the bath varies as electrolysis proceeds. Electrolyte is absorbed by the lining, which becomes saturated in the first 80 to 85 days of operation. The electrolytic bath normally operates at approximately 950°C . The aluminum reduction reaction results in reducing trivalent aluminum (Al^{+3}) to liquid metal at the cathode. Oxygen appears at the anode and reacts with the anode to form a mixture of 75 percent carbon dioxide and 25 percent carbon monoxide, consuming the carbon anode (6). The main electrochemical reaction occurring is represented by the following equation, with the aluminum being deposited at the bottom of the cell: $2\text{Al}_2\text{O}_3$ (dissolved) + $3\text{C}(\text{s}) \rightleftharpoons 4\text{Al}(\text{l}) + 3\text{CO}_2(\text{g})$.

Figure 2–2. Simplified Diagram of a Typical Pot



Reference: U.S. EPA, Office of Water, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Primary Aluminum Smelting Subcategory of Aluminum Segment of the Nonferrous Metals Manufacturing Point Source Category (5).

There are basically two types of cells that are used for the production of aluminum. These are referred to as pre-baked anode (intermittent replacement) and the Soderberg anode (continuous replacement). The primary difference between the cells is the manner in which the anode is baked and consumed. For either system, the anode preparation begins in the anode paste plant, where petroleum coke and pitch are hot blended. For prebaked anodes, the anode paste is pressed in molds, and the anodes are baked in an anode bake plant. The baked anodes are used to replace consumed anodes. In the Soderberg anode system, the anode paste is not baked initially, but is fed continuously in the form of briquettes through the shell of the pot. As the anode is consumed in the pot, it must be continually lowered to maintain a constant depth of anode immersed within the electrolyte. Additional paste is added to the top of the anode to replace the

consumed anode. As the paste approaches the hot bath, the paste is baked in place to form the anode. Soderberg anodes are supported in the pot by one of two methods: vertical stud Soderberg (VSS) or by horizontal stud Soderberg (HSS) (5). While all electrolytic pots operate on the same principles, the pots produced by each aluminum company may vary in design. The same facility conducting aluminum reduction may also produce (and bake) anodes.

At predetermined intervals the overlaying crust is broken into the bath. Alumina is added to the bath intermittently to maintain the concentration of dissolved alumina within a desired range. The molten aluminum is collected from each pot by siphoning a measured aliquot from the cell into a transportable vessel. The aluminum is then taken directly to the casting process to be cast into ingots or pigs as the final product in a separate casthouse facility or it is taken to a holding furnace.

It is essential for purity of the product aluminum and the structural integrity of the cell that the molten aluminum be isolated from the steel shell. Over the life of the cathode, the carbon materials become impregnated with the cryolite electrolytic solution. As the cryolite is absorbed into the cathode, the integrity of the lining can be reduced and cracks or heaving of the lining can occur. A pot “fails” when iron is detected in the molten aluminum, when cell voltage increases, or when the shell leaks molten metal or electrolyte. The iron contamination can be caused by the development of cracks or by erosion in the carbon lining, which allow electrolyte to come in contact with the steel collector bars or steel shell. Upon failure of a liner, the cell is emptied and cooled. The pot is then removed from the cellroom to a working area or dismantled in place. By mechanical drilling and/or soaking in water, the steel shell is stripped of the carbon lining. There are two portions of spent potliner. These are designated as first cut and second cut potliner. First cut potliner consists of the upper portions of the carbon from the bottom block and side walls. Second cut material is the thermal insulation composed of carbon insulating brick or alumina. The first cut carbon lining is the subject of the K088 listing. The second cut, which includes the steel collector bars, steel shell, insulating brick, and possibly molten aluminum, is segregated or co-disposed. Aluminum may be present in the second potliner if the carbon lining cracks or erodes and allows electrolyte to come in contact with the shell or collector bars. Following removal from

the cell, the spent potliner is generally stored in rail cars, dumpsters, or piles prior to treatment and disposal.

The service life of a pot is variable. At one facility, a service life of four years is typical (Appendix H; 1999 site visit report). Older information from 1980 report that four to seven years for a potliner is common, with a service life of up to ten years in some cases (7). Some of the factors that may impact the potlife include strength of the pot shell, cell preheat procedures, quality of cathode blocks and sidewall blocks, and type of ramming paste. While a longer service life reduces the generation rate of hazardous waste (and the costs for management), longer use of a potliner may detrimentally affect the quality of the aluminum produced.

2.1.2 Size and Geographical Distribution of Facilities

Currently, there are 23 aluminum reduction facilities (each generating spent potliners) operated in the United States. These facilities produced an estimated 3,700,000 metric tons of aluminum in 1998, which were produced in the following states (8; 9):

Indiana	Ohio
Kentucky	Oregon
Maryland	South Carolina
Missouri	Tennessee
Montana	Texas
New York	Washington
North Carolina	West Virginia

Table 2–1 provides a list of these facilities. This list includes the name and location of the facility, aluminum reduction capacity, and quantity of spent potliner generated in 1997. Figure 2–3 shows a map with the approximate location of each facility.

Table 2–1. Aluminum Reduction Facilities Generating Spent Potliner

Company	Location	1997 Year-End Reduction Capacity (Thousand Metric Tons) ^a	1997 Spent Potliner Generation Rate (Tons)
Alcan	Sebree, KY	186	3,658
Alcoa	Evansville, IN	300	6,069
Alcoa	Badin, NC	115	1,169
Alcoa	Alcoa, TN	210	1,069
Alcoa	Rockdale, TX	315	7,119

Table 2–1. Aluminum Reduction Facilities Generating Spent Potliner

Company	Location	1997 Year-End Reduction Capacity (Thousand Metric Tons)^a	1997 Spent Potliner Generation Rate (Tons)
Alcoa	Wenatchee, WA	220	2,469
Alcoa	Massena, NY	125	2,043
Alumax	Mt. Holly, SC	205	2,449
Alumax/Eastalco	Frederick, MD	174	2,469
Alumax/Intalco	Ferndale, WA	272	8,681
Goldendale Aluminum Corp.	Goldendale, WA	160	6,527
Columbia Falls Aluminum Co.	Columbia Falls, MT	168	4,558
Kaiser Aluminum	Tacoma, WA	73	2,253
Kaiser Aluminum	Spokane, WA	200	NA
NSA	Hawesville, KY	186	3,096
Noranda Aluminum	New Madrid, MO	215	5,643
Northwest Aluminum	The Dalles, OR	82	1,212
Ormet Corporation	Hannibal, OH	256	5,170 ^b
Century Aluminum Corp.	Ravenswood, WV	168	6,546
Reynolds Metals Co.	Massena, NY	123	3,981
Reynolds Metals Co.	Longview, WA	204	4,987
Reynolds Metals Co.	Troutdale, OR	121	NA
Vanalco	Vancouver, WA	116	2,634
Total		4,190	83,802

^aThe 1997 Year End Reduction Capacity was determined based on the facilities' available *capacity* to produce the reported amounts of aluminum. These numbers do not represent actual production of aluminum in 1997; actual year- end production information was unavailable.

^bNote that this amount of potliner generated at Ormet Corporation does not represent the amounts of baghouse dust and treated residue generated as a result of treatment since the current full-scale process was not operated at that time.

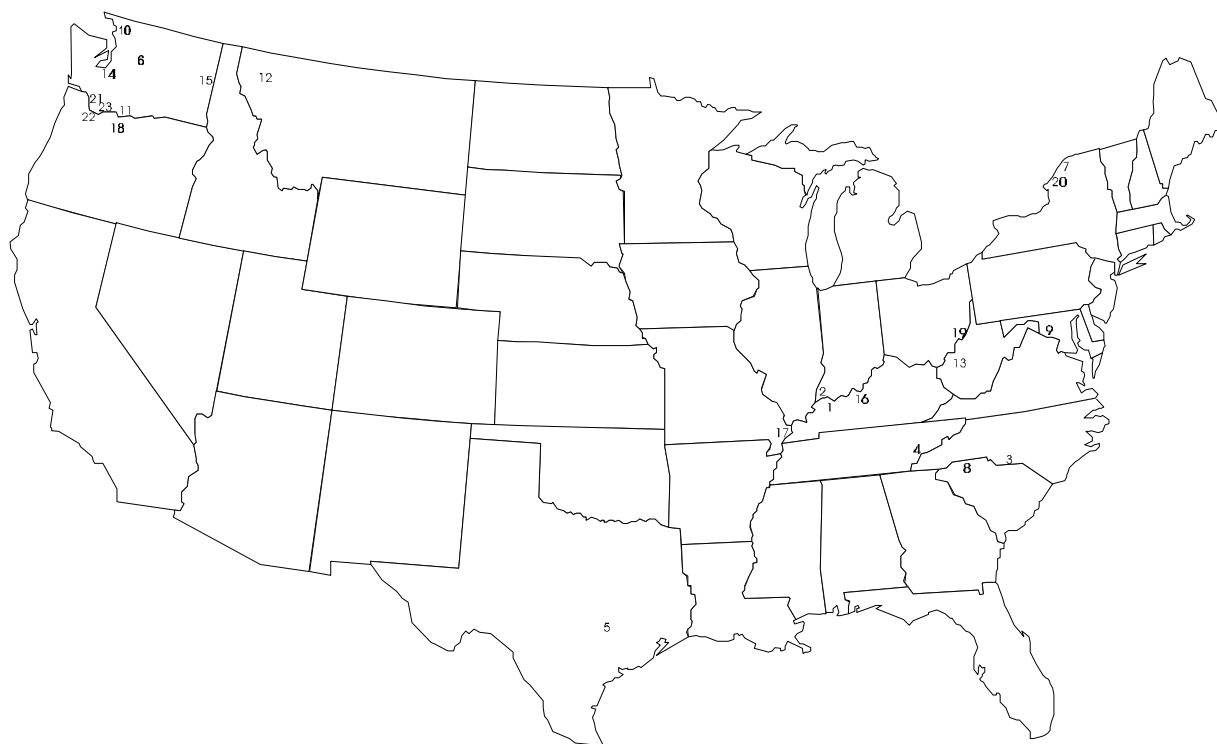
NA: Data not available in 1997 BRS for this facility.

References:

U.S. Geological Survey, Minerals Information 1997, Aluminum (8).

1997 Biennial Reporting System, public release version April 1999 (14).

Figure 2–3. Locations of Aluminum Reduction Facilities Generating Spent Potliner



1. Alcan—Sebree, KY
2. ALCOA—Evansville, IN
3. ALCOA—Badin, NC
4. ALCOA—Alcoa, TN
5. ALCOA—Rockdale, TX
6. ALCOA—Wenatchee, WA
7. ALCOA—Massena, NY
8. Alumax—Mt. Holly, SC
9. Alumax/Eastalco—Frederick, MD
10. Alumax/Intalco—Ferndale, WA
11. Goldendale Al. Corp.—Goldendale, WA
12. Columbia Falls Al. Co.—Columbia Falls, MT

13. Century Aluminum—Ravenswood, WV
14. Kaiser Aluminum—Tacoma, WA
15. Kaiser Aluminum—Spokane, WA
16. National Southwire—Hawesville, KY
17. Noranda Aluminum—New Madrid, MO
18. Northwest Aluminum—The Dalles, OR
19. Ormet Corp—Hannibal, OH
20. Reynolds Metals—Massena, NY
21. Reynolds Metals—Longview, WA
22. Reynolds Metals—Troutdale, OR
23. Vanalco—Vancouver, WA

Reference: U.S. Geological Survey, 1997 Minerals Information: Aluminum (8).

Table 2–1 also includes the K088 generation rate from the 1997 Biennial Reporting System (BRS) database. A total of 21 reduction facilities generating K088 reported data to the 1997 BRS.^{6,7} As shown in Table 2–1, approximately 84,000 tons of K088 were generated in

⁶ A total of 23 facilities currently use processes that generate K088, but two facilities did not report any K088 generation data for 1997. This may be because some facilities may have been idle, may not have generated K088 in the reporting year, or they may have labeled their 1997 National Biennial Reports as Confidential Business Information (CBI).

⁷In support of K088 treatment standard development, the Agency has collected data on K088 generation from 1991 to 1998 BRS reports. However, within this Background Document EPA has analyzed and included the most recent data collected from the 1997 BRS and the 1998 BRS.

1997. Table 2–1 also shows that Alcoa, Alumax, Reynolds Metal, Century Aluminum, and Goldendale Aluminum Corporation, with 19,938, 13,599, 8,968, 6,546, and 6,527 tons, respectively, were top generators of spent potliner in 1997.

Domestic primary aluminum production has been rising since 1994. In 1994, 3.3 million metric tons of primary aluminum were produced compared with 3.7 million metric tons in 1998. Additional production capacity remains, with approximately 430,000 metric tons remaining idle as of October 1998. The estimated aluminum reduction capacity in 1998 was 4.2 million metric tons per year (9).

2.1.3 Aluminum Products and Their Uses

Aluminum and its alloys have properties that make it one of the most widely used metals in the world. The best known property of aluminum is its light weight. Its specific gravity is 2.7 and is approximately one-third as dense as iron, copper or zinc. Despite its light weight, it can be made strong enough to replace heavier and more costly metals in many applications. Aluminum and its alloys are highly resistant to corrosion making them very useful in coating applications. Its high electrical conductivity and comparative low density make aluminum ideal for many electrical transmission and distribution uses. Because aluminum is an excellent conductor of heat, it is widely used in heat exchange applications such as radiators and cooling coils. In addition, aluminum is an excellent reflector of all forms of radiant energy, which results in wide use in roofing materials and building insulation. Because aluminum is effective at keeping heat in or out it is also widely used as food wraps.

2.2 Waste Stream Characteristics

2.2.1 Waste Stream Status Under Other Regulations

Under the Clean Water Act, the discharge of pollutants into surface waters and Publicly-Owned Treatment Works (POTWs) from primary aluminum smelting facilities is regulated under the Aluminum Segment of the Non-ferrous Metals Manufacturing Point Source Category (40

CFR Part 421 Subpart B). This subpart includes effluent limitations and standards for cyanide, fluoride, antimony, nickel, aluminum, benzo(a)pyrene, oil and grease, total suspended solids (TSS), and pH for wastewaters discharged from the aluminum reduction process, including wastewaters from the anode and cathode paste plants, anode bake plant, cathode reprocessing, potliner and potroom air pollution control, aluminum degassing, pot repair and soaking, and aluminum casting.

Of the two constituents for which EPA is proposing revised standards, cyanide compounds (as a class) are regulated under the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313. Under Section 313, facilities that manufacture, process, or otherwise use these chemicals, and that meet certain other criteria, must report the releases and transfers of these chemicals.

Air emissions from aluminum production have been regulated by EPA under the Clean Air Act since the 1970s. A principal constituent of concern is fluoride, present as hydrogen fluoride (HF) in vapor form as well as in particulates entrained in offgas. A common treatment technique is the use of dry scrubbers, which collect particulates and sorb HF on alumina which is reused in the cells. When introduced to the cell, the alumina/hydrogen fluoride is converted to molten AlF_3 (27). Dry scrubbers are used at most U.S. aluminum reduction facilities and represent the most efficient technique for fluoride removal (61 Federal Register 50558, September 26, 1996).

Rules for air emissions (National Emission Standards for Hazardous Air Pollutants, or NESHAPs) from primary aluminum production were most recently revised on October 7, 1997 (62 FR 52383). This final rule affects three separate plant areas: the potliner (i.e., the electrolytic reduction of alumina that generates K088), the paste production plant (i.e., mixing of petroleum coke and coal tar pitch to make green anodes), and the anode bake furnace (i.e., the baking of green anodes in a furnace for use in the potliner). The final rule limits emissions of polycyclic organic matter (including polynuclear aromatic hydrocarbons) for all three areas and total fluoride for the potliner and anode bake furnace areas. Limits for total fluoride emissions from the potliner area range from 1.6 to 3.0 pounds fluoride per ton of aluminum produced, and polycyclic organic matter emissions from the potliner area range from 2.4 to 4.7 pounds per ton of aluminum

produced (depending on the potliner technology used at each particular plant). EPA had previously set Standards of Performance for New Stationary Sources (under the Clean Air Act) that required any facility that commenced construction or modification after October 23, 1974 to meet emissions standards for fluoride and opacity; such standards were amended with the new NESHAP rules.

In calculating limits from potliner emissions for this NESHAP rule, EPA identified a control option consisting of a dry alumina scrubber (with a baghouse to collect the alumina and other particulate matter) at those plants that do not have them. Additional reduction techniques that were identified included work practice improvements, equipment modifications, operating practices, housekeeping measures, and in-process recycling.

2.2.2 Waste Stream Descriptions

Waste characterization data for nonwastewater forms of K088 were obtained during EPA-conducted sampling in 1990, additional waste characterization data was submitted to the Agency with delisting petitions (6 and 11) and in conjunction with revised treatment standard development since 1997. Although the Agency urges submitters to include valid quality assurance/quality control information with their K088 waste sampling data, most facilities provided characterization data on spent potliners that was limited to a few constituents (e.g., cyanide) and generally lacked the rigorous QA/QC requirements of the Land Disposal Program.⁸ EPA has included these characterization data of spent potliner samples from eight aluminum reduction facilities in Table 2–2. Constituents found in this waste included polynuclear aromatic hydrocarbons and metals, including arsenic, fluoride, and cyanide. Generally, concentrations of these constituents in spent potliners are as follows: <0.005mg/kg to 200 mg/kg polynuclear

⁸Generally, the Agency requests that submitters provide detailed quality assurance/quality control data along with facility data measured from samples. Quality assurance/quality control data should include, but is not limited to, documentation of basis for selecting sample point, documentation that SW-846 sample preservation procedures were followed, and documentation that chain-of-custody procedures were followed. Sample analysis data should include documentation of instrument calibration procedures, clearly-labeled results of blanks for field analysis, laboratory , and trips, matrix spike duplicates, detection limits, and documentation of quantitative results of all method-specific QC procedures for each sample reported. For more information on this guidance, see the Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance, Quality Control Procedures, and Methodologies, October 1991 (1).

aromatics, <1.1 to <40 mg/kg arsenic, 18.25 mg/kg to 9,190 mg/kg total cyanide, 2.6 mg/kg to 4,800 mg/kg amenable cyanide, 230 mg/kg to 135,000 mg/kg fluoride, and various concentrations of other hazardous metals.

As shown in Table 2–2, concentrations of total cyanide ranged from 18.25 mg/kg to 9,190 mg/kg, varying greatly among the eight facilities. Four of the eight facilities had analyzed for samples of amenable cyanide, and those concentrations ranged from 2.6 mg/kg to 4,800 mg/kg. Average concentrations of total cyanide were 2,646 mg/kg, while average concentrations of amenable cyanide were 1,676 mg/kg. Possible variation among facilities may be the result of varying qualities of aluminum oxide used within the aluminum reduction process. The life of the steel pot may also affect the quality of aluminum produced and concentration levels of the waste constituents. Levels of cyanides vary from pot to pot and within a pot. Within a pot, levels can vary between the bottom of the pot liners and its side or end walls. Cyanide is also found in higher concentrations at the side wall where the bottom block carbon is exposed to air. Total cyanide may vary by two orders of magnitude within a single pot.

Fluoride, mostly in the form of sodium fluoride, was also detected at high concentrations in these wastes, ranging from 230 mg/kg to 135,000 mg/kg. In contrast to cyanide, fluoride is generally found in the bottom block carbon since it is in direct contact with the molten fluoride salt. Again, possible variations among facilities may be due to different qualities of aluminum oxide longer usage of the steel pot, which may affect the quality of aluminum produced and concentration levels of the waste constituents.

Table 2–2. Waste Characterization Data for K088 Spent Potliner^a

	Facility Number							
	Alcoa, Massena, NY	Alumax/Eastalco, Frederick, MD	Noranda Aluminum, New Madrid, MO	Reynolds Metals, Longview, MA	Reynolds Metals, Massena, NY	Reynolds Metals, Baie Comeau, Quebec	Reynolds Metals, Troutdale, OR	Ormet Corporation, Hannibal, OH ^b
Constituent	Total Composition Concentration (mg/kg)							
aluminum	47,900	46,400	53,400	NA	NA	NA	NA	NA
antimony	3.6	<6.5	<1.4	9.9–12.0	5.4–14.0	7.0–9.8	<0.34–<3.3	<10
arsenic	<2.2	<25.7	<1.1	<20	<20	<20	<40	3.1–7
barium	145	153	149	100–110	130–150	97–130	150–180	180–210
beryllium	8.4	2.6	23.3	15–20	30–32	9.6–13	16–19	36,906
cadmium	<0.42	<0.28	0.7	0.63–1.10	0.37–0.48	0.44–0.96	<0.39–0.44	<0.5
calcium	15,000	24,500	11,600	NA	NA	NA	NA	NA
chromium	35.9	18.4	41.1	14–53	36,841	16–22	15–26	28–59
cobalt	9.9	5.0	11.9	2.5–4.3	2.4–3.0	5.8–11.0	4.1–5.2	NA
copper	8.8	3.9	16.9	40–76	28–67	32–56	34–56	NA
iron	3,280	1,850	4,360	NA	NA	NA	NA	NA
lead	8.7	11.7	16.7	9.7–13	8.9–11	7.6–19	4.8–26	20–26
lithium	23.4	167	6,880	NA	NA	NA	NA	NA
magnesium	555	626	518	NA	NA	NA	NA	NA
manganese	116	22.5	26.4	NA	NA	NA	NA	NA
mercury	<0.085	<0.097	<0.093	<0.10	<0.10	<0.10	<0.1	<0.25
molybdenum	<0.59	<7.0	1.9	NA	NA	NA	NA	NA
nickel	13.7	6.0	52.3	18–36	32–64	38–60	24–51	20–23
potassium	597.0	376.0	774.0	NA	NA	NA	NA	NA
selenium	<3.4	<2.2	10.8	<4.0	<4.0	<4.0	<2.0	<0.2–2
silver	<0.25	<0.37	<0.39	<0.63–0.67	<0.69	<0.69	<0.66–0.99	<2

Table 2–2. Waste Characterization Data for K088 Spent Potliner^a

	Facility Number							
	Alcoa, Massena, NY	Alumax/Eastalco, Frederick, MD	Noranda Aluminum, New Madrid, MO	Reynolds Metals, Longview, MA	Reynolds Metals, Massena, NY	Reynolds Metals, Baie Comeau, Quebec	Reynolds Metals, Troutdale, OR	Ormet Corporation, Hannibal, OH ^b
Constituent	Total Composition Concentration (mg/kg)							
sodium	121,000	177,000	179,000	NA	NA	NA	NA	NA
strontium	48.1	153	147	NA	NA	NA	NA	NA
thallium	11.9	<5.4	20.4	<0.50	<0.50	<0.50	<0.5	<0.25–<0.5
tin	<210	<234	<247	150–180	130–170	100–130	85–110	<0.5–1.1
vanadium	20.5	6.6	60.4	22–23	33–38	42–52	28–34	<50
zinc	7.0	10.4	22.6	32–44	24–63	40–62	23–27	0.8–6.1
cyanide (total)	810	1,010	9,190	415–1,110	45.5–773	18.5–80.1	1,300–5,800	840–2,400
cyanide (amenable)	NA	NA	NA	415–1,110	39–772	2.6–25.3	200–4,800	NA
fluoride	17,700	18,000	20,200	6,910–31,400	39,200–64,700	230–135,000	61,000–113,000	73,000–110,000
sulfide	304	104	112	NA	NA	NA	NA	NA
phosphorous	135	83.1	189	NA	NA	NA	NA	NA
acetone	<0.05	0.41	0.35	<0.063	<0.063	<0.063	<1.0	<10–<20
acetonitrile	<0.025	0.2	<0.100	<0.050	<0.050	<0.050	<1.0	NA
acrolein	<0.025	1.2	<0.050	<2.5	<2.5	<2.5	<0.75	NA
benzene	<0.025	0.008	<0.005	<0.050	<0.050	<0.050	<0.050	<0.5–<1.0
carbon disulfide	0.043	<0.005	<0.005	<0.050	<0.050	<0.050	<0.050	<0.5–<1.0
chloroform	<0.025	<0.005	<0.005	<0.050–0.089	<0.050	<0.050–0.081	<0.050	<1
dichlorodifluoromethane	<0.025	<0.005	<0.005	<0.63–1.0	<0.63	<0.63	<0.050	<0.5
ethyl cyanide	<0.025	0.021	<0.005	NA	NA	NA	NA	NA
methyl ethyl ketone	<0.05	0.014	0.011	<0.25–0.31	<0.25–0.58	<0.25	<1.0	<20
methylene chloride	<0.025	<0.005	0.009	<0.25–0.30	<0.25	<0.25	<0.050	<1

Table 2–2. Waste Characterization Data for K088 Spent Potliner^a

	Facility Number							
	Alcoa, Massena, NY	Alumax/Eastalco, Frederick, MD	Noranda Aluminum, New Madrid, MO	Reynolds Metals, Longview, MA	Reynolds Metals, Massena, NY	Reynolds Metals, Baie Comeau, Quebec	Reynolds Metals, Troutdale, OR	Ormet Corporation, Hannibal, OH ^b
Constituent	Total Composition Concentration (mg/kg)							
pyridine	<0.025	1.6	<0.250	<1.0	<1.0	<1.0	<1.0	NA
toluene	0.23	0.009	<0.005	<0.050	<0.050	<0.050	<1.0	<0.5–<1.0
trichloromonofluoromethan	<0.050	<0.010	0.02	<0.25	<0.25	<0.25	<1.0	NA
bis(2-ethylhexyl)phthalate	0.31	<0.680	<0.990	<1.0	2.8	<1.0	<1.0	<0.160
anthracene	<0.660	<0.680	<0.990	<10	<10	18–31	<1.0	<0.160–0.32
benz(a)anthracene	<0.660	<0.680	<0.990	<10–15	15–44	87–160	<1.0	<0.160–0.61
benzo(a)pyrene	<0.660	<0.680	<0.990	<10–12	22–59	92–180	<1.0	<0.160
benzo(b)fluoranthene	<0.660	<0.680	<0.990	25–52	67–180	190–310	<1.0	<0.160–0.170
benzo(k)fluoranthene	<0.660	<0.680	<0.990	25–52	67–180	190–310	<1.0	<0.160
benzo(g,h,i)perylene	<0.660	<0.680	<0.990	<10	14–47	71–140	<1.0	<0.160
chrysene	<0.660	<0.680	<0.990	17–45	39–88	140–200	<1.0	<0.160–1.2
dibenz(a,h) anthracene	<0.660	<0.680	<0.990	<10	<10–14	24–48	<1.0	<0.160
di-n-octyl phthalate	<0.660	<0.680	<0.990	<10	<10	<10	<1.0	0.38–12
fluoranthene	<0.660	<0.680	<0.990	<10–12	34–78	170–240	<1.0	0.26–5.7
indeno(1,2,3-cd)pyrene	<0.660	<0.680	<0.990	<10	12–37	64–120	<1.0	<0.160
phenanthrene	<0.660	<0.680	<0.990	<10	<10–28	91–140	<1.0	<0.160–2.3
pyrene	<0.660	<0.680	<0.990	<10–13	18–65	130–200	<1.0	0.2–8
butyl benzyl phthalate	0.25	<0.680	<0.990	NA	NA	NA	NA	NA
hexachlorodibenzofurans	0.38	NA	NA	NA	NA	NA	NA	NA

^a The waste characterization data for the K088 constituents listed within this table were gathered from EPA sampling activities and data provided in delisting petitions (6, 10, and 11).

^b Data presented in this table are from spent potliner samples at Ormet Corporation's Hannibal, Ohio facility which does not include the newer 1999 data. Ormet's operation generates waste constituents having far lower concentrations, and may be due to the fact that the facility uses steel pots in their aluminum reduction process for only three years compared to some potliners being serviced for up to seven years. To compare current data collected from Ormet Corporation's full-scale facility, refer to section 3.3.

NA: Not Analyzed

2.3 Waste Stream Management

2.3.1 Description of K088 Waste Management Practices

EPA has identified management techniques for K088 waste, such as recycling, reclamation, reuse, stabilization, chemical precipitation, and treatment. In addition, the Agency collected and analyzed treatment performance data from CWMNW facility in Gilliam County, Oregon and Ormet Corporation in Hannibal, Ohio in 1999. The Agency also analyzed treatment performance data already made available from Reynolds Metal Company facility in Gum Springs, Arkansas. Reynolds and CWMNW employ commercial treatment systems, while Ormet treats wastes only at its single location (Ormet does not treat wastes generated by other facilities). According to information collected and received by EPA, these are the only full-scale treatment technologies currently managing K088 waste⁹. The practices of Reynolds and Ormet are discussed in detail in Sections 3.2 and 3.3. Data submitted to the Agency by CWMNW in 1999 was labeled as Confidential Business Information (CBI) and, therefore, is not presented in this Background Document.

2.3.2 Waste Minimization and Recycling Activities

As indicated in Section 2.1, a pot life can vary between facilities. EPA has no new information regarding waste minimization at aluminum reduction facilities. However, limited study and implementation are being performed on methods to reduce spent potliner generation. Studies have been performed to determine the impact of several factors on the life of a cell. Research has concluded that one of the most important factors in increasing potlife expectancy is use of stronger steel shells that limit the deformation of the cathode. Other factors that can affect the potlife include cell preheat procedures, use of high quality cathode blocks, use of sidewall

⁹In December 1998 - March 1999, EPA sent Letters of Inquiry to companies, identified in the background document for the Phase III rule, requesting treatment performance data or additional information regarding the treatability of K088 waste at their facilities. Telephone calls followed, and only CWMNW responded with treatment performance data to support their operations. No other companies submitted performance data or additional information to the Agency. Results of additional inquiries only suggest that there may be other treatment processes, but none have reached the pilot-scale testing phase. Refer to Docket Listing 15: Elaine Eby, U.S. EPA, Office of Solid Waste, Inquiry Letters on K088 Waste, December, 1998 - March 1999.

blocks with higher thermal conductivity, use of ramming pastes with better physical and mechanical characteristics, and balancing of the magnetic field in the cell (15).

One of the most effective methods of source reduction is the recycling of post-consumer aluminum. Increasing the recycling of post consumer aluminum reduces the demand for virgin aluminum and, thus, the generation of spent potliner. In 1997, the quantity of aluminum produced from primary operations was 3,600,000 metric tons and the quantity produced from secondary sources (scrap) was 1,500,000 metric tons (9). Therefore, production of aluminum from scrap accounts for approximately 30 percent of domestic production (combined primary and secondary).

In addition, Ormet Corporation and Vortec formed a joint effort in 1997 to assist in the development of waste recycle, specifically, treating K088 and converting process residue into glass and ceramic products for beneficial reuse available to other industries. As presented in this Background Document, Ormet Corporation also currently recycles a portion of its resulting fluoride-rich dust, generated from its K088 treatment process.

3.0 TREATMENT STANDARD DEVELOPMENT FOR K088

3.1 Identification of Technologies for the Treatment of Spent Potliners

Typically, in order to establish BDAT, the Agency first identifies which technologies are “applicable” for treatment of the constituents of concern.¹⁰ The Agency next determines which of the applicable technologies are “demonstrated” for treatment of the wastes; specifically, a demonstrated technology must be one that is used in a full-scale operation for treatment of the waste of interest or a similar waste. The Agency then determines if the demonstrated technologies are “available” (for purchase if patented or proprietary) and provide substantial treatment. Finally, based on a thorough review of all performance data on the treatment of the waste of concern or wastes that are similar, the Agency identifies a “best” demonstrated technology as BDAT.

EPA uses a hierarchy of options for evaluating treatment or recycling technologies. The Agency’s ultimate goal for hazardous waste is source reduction, that is, less or no production of hazardous waste. The next preferred option is total recycle or reuse. That would require that all the waste generated be used as feedstock in the same process or another process. First in the hierarchy would be treatment technologies that can recover materials from the waste for reuse. This option also may result in some residuals still needing to be land disposed, but preferred techniques would also significantly reduce the quantity and toxicity of any waste destined for land disposal. Next, EPA prefers technologies that reduce quantity and toxicity without the recovery of materials for reuse. Last would be technologies that lower toxicity alone and may increase volume of materials for land disposal. At the base of this hierarchy are numerical treatment standards. Numerical treatment standards are required for treatment or recovery technologies

¹⁰An applicable technology is one which, in theory, can treat the waste in question or a waste similar to the waste in question in terms of parameters that affect treatment selection. Detailed descriptions of the technologies identified as applicable for the treatment of listed hazardous wastes are provided in EPA’s *Final Treatment Technology Background Document* (16). The identification of treatment technologies as applicable for treating BDAT List constituents is based on evaluation of current waste management practices, current literature sources, field testing, data submitted by equipment manufacturers, and industrial concerns, plus engineering judgment of EPA technical staff personnel.

that result in residuals requiring land disposal. Treatment residuals must, therefore, comply with applicable treatment standards prior to land disposal.

EPA has identified a broad range of treatment, recycling, reclamation, and reuse practices as applicable technologies to K088. Some of these technologies also process K088 into marketable products. For example, some industrial furnaces and calciners enable the use of fuel values and the reuse of valuable materials such as sodium aluminum fluoride salts and un-burned carbon. It is believed that while the carbon in K088 can be used as a reducing agent for metals processed in iron and steel furnaces, the sodium aluminum fluoride salts can also serve as a substitute for fluor-spar (calcium fluoride) when K088 is pretreated with limestone.¹¹ Because nonwastewater forms of the K088 wastes contain organic constituents, as well as cyanide, fluoride and other toxic metals, applicable technologies include those that destroy or reduce the total amount of various organic compounds, as well as recover or fixate the metals and fluorides present.

In the *Proposed Best Demonstrated Available Technology Background Document for Spent Potliners from Primary Aluminum Reduction—K088* (January 13, 1995) (20), the Agency provided detailed discussion of the applicable technologies that were in development or in use for the treatment of spent potliners. The process descriptions are presented in alphabetic order by firm or technology. Since publication of the 1995 Background Document, the Agency has collected additional performance data on the treatment of K088 waste from aluminum producing facilities, including submissions from Ormet Corporation, Reynolds Metal, and CWMNW.¹² This background document, however, provides updated, process information and performance data from only two facilities – Ormet and Reynolds. The Reynolds data was gathered from information cited in the August 1998 Notice of Data Availability (NODA), and the Ormet data was collected during a sampling effort in June 1999. The updated information demonstrates that treatment technologies used at Ormet and Reynolds lower toxicity and reduce quantity, along

¹¹The fluor-spar serves as a furnace fluxing agent for industrial furnaces that make iron and steel, as well as a flux and as an opacifier in the manufacture of glass and enamel and welding rod coatings.

¹²Note that the Agency reviewed full-scale treatment system performance data submitted in 1999 from CWMNW, located in Gilliam County, Oregon, but did not present the CBI data in this document

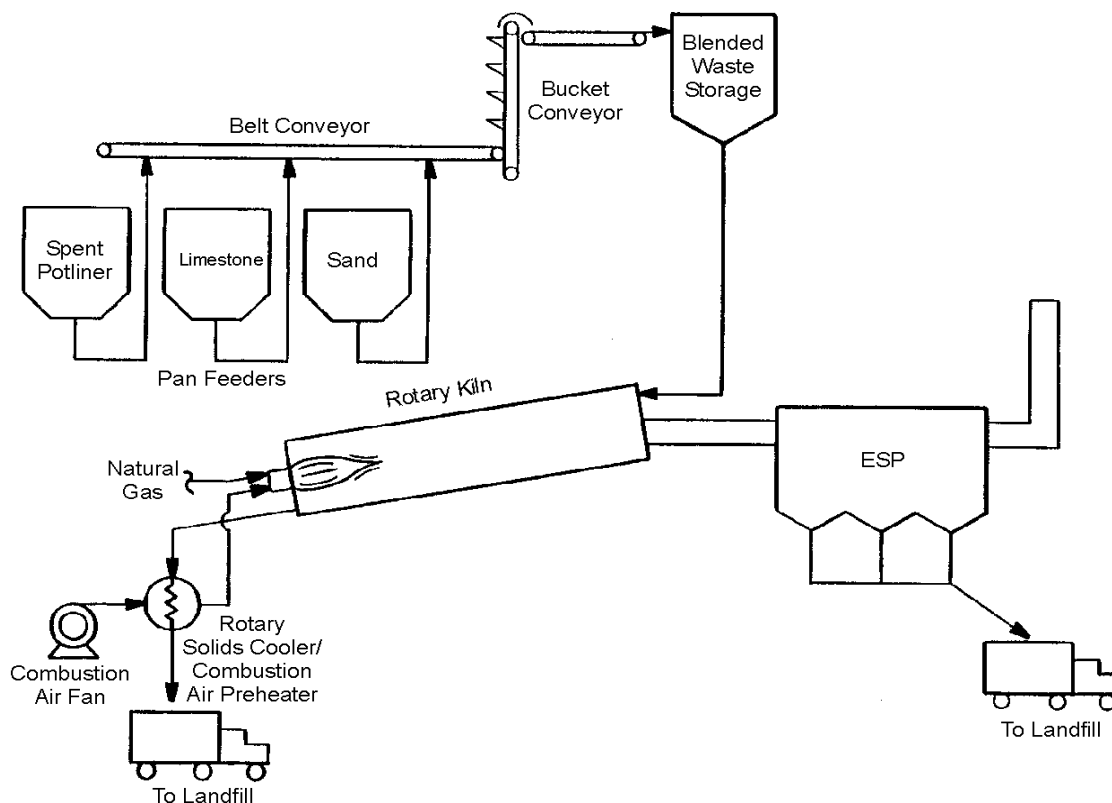
with possibly providing beneficial reuse. Reynolds Metal and Ormet Corporation have thermal treatment systems that destroy, reduce, and recover toxic constituents found in K088 wastes.

3.2 Reynolds Metal, Gum Spring, Arkansas

Reynolds Metals developed a process to thermally treat spent potliner in a rotary kiln in (11). The Arkansas facility uses two kilns to treat spent potliner generated from Reynolds as well as other companies that generate K088. The facility began operation in October 1993 (25).

A schematic of the Reynolds process is presented in Figure 3–1. In the rotary kiln treatment process, spent potliner is transported to the Arkansas facility by rail or truck, then stored onsite in shipping containers. The spent potliner is crushed and milled to a 3/8-inch particle size, and conveyed to a kiln feed bin with two other raw materials, limestone and red clay sand. (The role of these raw materials are detailed later in this section.) The crushed spent potliner, red clay sand, and limestone can then be blended in varying ratios depending on the results of initial spent potliner characterization (i.e., the greater the cyanide and fluoride levels in the spent potliner, the more red clay sand and limestone is added). Typical rates of these raw materials were previously reported in 1994 as 25 to 35 percent K088, 30 to 50 percent limestone, and 25 to 35 percent sand (25), and are consistent with a ‘recipe’ provided in more recent correspondence in late 1996 (26).

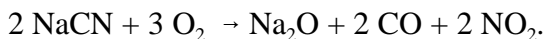
Figure 3–1. Schematic of the Reynolds Treatment Process



Reference: Reynolds Metal Company, *Petition for Exclusion for Spent Potliner Generated at Reynolds Metal Company Hurricane Creek Facility, Hurricane Creek, AK* (11).

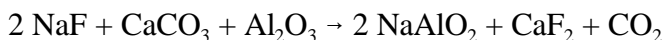
The material is fed from the feed bin to each kiln at a rate of up to 24 tons per hour (this rate refers to the mixture of the potliner, sand, and limestone). Each kiln is approximately 250 feet in length and 9.5 feet in diameter. The kiln is fueled by natural gas which passes through the kiln in a direction countercurrent to the solid feed, with the kiln reaching a temperature of 1,200 °F at the solid material discharge (i.e., in countercurrent operation, the gas inlet corresponds to the kiln residue outlet). The kiln residue is cooled by spraying with lake water and stored in bins; each bin can hold 24 hours of generated material. The kiln residue is disposed in a landfill. The flue gas is sent through cyclones and an electrostatic precipitator (ESP) to remove solids. Reynolds recycles the solids from the cyclones back to the kiln; solids generated from the ESP are disposed, as they meet current K088 treatment standards required for land disposal.

One of the purposes of an elevated kiln temperature is to thermally destroy cyanide present in the spent potliner as sodium cyanide (NaCN). This is shown by the following chemical reaction (25):



Raw Materials

Reynolds treatment process uses limestone and red clay sand as raw materials in conjunction with the spent potliner. The spent potliner (K088) is generated at aluminum reduction facilities throughout the United States. The purpose of the red clay sand is to facilitate the flow of material through the rotary kiln and prevent fusion at the elevated temperatures. For this reason the sand is referred to as an anti-agglomeration agent. The purpose of the limestone is to react with the sodium fluoride (NaF) and cryolite (Na_3AlF_6) in the spent potliner to form less soluble calcium fluoride. (Limestone is chiefly comprised of calcium carbonate, CaCO_3 . Another reactant is aluminum oxide, Al_2O_3 , which is present in the spent potliner.) This performance is shown by the following chemical reactions (25):



When Reynolds first began treating spent potliner, it used *brown sand* as an anti-agglomeration agent. This is an alkaline mud generated during the extraction of alumina from mined bauxite (the alumina is subsequently used for aluminum production). As a result of previous site operations, large quantities of this material are present in the vicinity of the Reynolds rotary kilns. Reynolds later investigated alternatives to this raw material because the kiln residue exhibited high pH. Specifically, this high pH was found to result from use of the *brown sand*, which is alkaline because it is generated from the digestion of bauxite in sodium hydroxide.

One of the alternative materials investigated in late 1996 was red clay sand (26). As subsequently reported in the Federal Register, this material was selected as a substitute for the alkaline *brown sand* (63 Federal Register 51254, September 24, 1998).

The rotary kiln is approximately 250 feet in length and 9.5 feet in diameter and operates counter-currently. Natural gas is used to heat the kiln to the 1200 °F operating temperature at the burner end. The flue gas is sent through cyclones and an electrostatic precipitator (ESP) to remove solids. Reynolds recycles the solids from the cyclones to the kiln; solids generated from the ESP are handled as hazardous waste. The kiln residue is cooled by contact spraying with lake water and stored in waste piles. Reynolds disposes of the kiln residue at a Subtitle C hazardous waste landfill.

Table 3–1 presents performance data submitted by Reynolds from their full scale kiln treatment process that was included in the August 1998 NODA. The data represents six samples analyzed prior to and following treatment for total and leachable cyanide and fluoride, and pH. Rather than using the TCLP, leaching was conducted using distilled water and with liquid to solid ratios less than those stipulated by the TCLP.¹³

¹³ The Toxicity Characteristic Leaching Procedure (TCLP), SW-846 Method 1311, uses an acidic leaching media and a 20:1 liquid to solid ratio. The leaching media consists of a sodium acetate solution, with a pH of 4.93, when used for samples with low alkalinity and a dilute acetic acid solution when used for samples with high alkalinity.

Table 3–1. Reynolds Data Presented in the August 1998 NODA for K088

Reported Sample Concentrations of Fluoride													
Total Constituent, mg/kg		Leachable Constituent Based on Analysis with Distilled Water (mg/L) ^a						pH Standard Units					
		Ratio 1:5		Ratio 1:10		Ratio 1:20		Ratio 1:5		Ratio 1:10		Ratio 1:20	
Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner
80,780	40,880	9,630	1,070	5,130	940	3,400	543	12.6	12.7	12.1	12.3	12.0	11.9
84,608	50,300	7,630	1,060	5,030	837	2,340	540	12.5	12.5	12.1	12.4	11.6	12.1
82,200	38,600	6,170	867	3,770	730	2,040	567	12.3	12.7	11.9	12.3	11.5	12.0
80,100	50,200	6,700	1,010	3,730	787	1,900	587	12.3	12.6	11.9	12.4	11.3	12.6
76,780	43,280	7,870	1,120	4,400	777	2,220	513	12.5	12.8	11.8	12.5	11.5	12.2
82,408	44,808	8,630	1,080	5,630	763	2,460	567	12.5	12.7	12.0	12.4	11.2	12.2
Reported Sample Concentrations of Cyanide													
Total Constituent, mg/kg		Leachable Constituent Based on Analysis with Distilled Water (mg/L) ^a						pH Standard Units					
		Ratio 1:5		Ratio 1:10		Ratio 1:20		Ratio 1:5		Ratio 1:10		Ratio 1:20	
Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner	Untreated Potliner	Treated Potliner
2,950	50	205	1.2	326	0.5	126	1.2	12.6	12.7	12.1	12.3	12.0	11.9
6,350	60	1,030	6.9	405	0.6	382	0.7	12.5	12.5	12.1	12.4	11.6	12.1
975	100	222	0.8	160	1.5	85	2.5	12.3	12.7	11.9	12.3	11.5	12.0
1,850	50	320	0.8	175	0.2	90	0.2	12.3	12.6	11.9	12.4	11.3	12.6
2,050	150	362	0.5	268	0.2	120	0.2	12.5	12.8	11.8	12.5	11.5	12.2
2,420	50	566	4.8	275	0.4	202	0.9	12.5	12.7	12.0	12.4	11.2	12.2

^aRather than using the TCLP, leaching was conducted using distilled water and with liquid to solid ratios less than those stipulated by the TCLP.

Reference: One-page "Special Laboratory Report" (December 6, 1996). Results from analysis of 6 samples of waste, analyzed prior to and following treatment at Reynolds Gum Springs Arkansas facility (11). No quality assurance/quality control documentation is provided. The source of the K088 potliner is not identified.

Untreated potliners from Reynolds consist of approximately 81,000 mg/kg of fluoride based on average totals analysis. When treated samples were analyzed based on totals analysis, fluoride concentrations ranged from 38,600 mg/kg to 50,300 mg/kg. Leachable concentrations of fluoride in the treated samples at a 1:5 solid/liquid ratio ranged from 867 mg/L to 1,120 mg/L, while the pH values ranged from 12.5 to 12.8. At a 1:10 solid/liquid ratio, leachable concentrations of fluoride ranged from 730 mg/L to 940 mg/L, and pH values ranged from 12.3 to 12.5. Leachable values ranged from 513 mg/L to 587 mg/L, and pH values ranged from 11.9 to 12.6 at a 1:20 solid/liquid ratio. When comparing the average concentration of 44,678 mg/kg of total fluoride in treated samples, Reynolds' treatment process removes approximately 0% of fluoride from untreated potliner. The removal of fluoride by the Reynolds process was calculated using the average concentration in treated residue divided by the average concentration in the untreated waste, multiplied by a factor of 2 to 3 to account for the sand and limestone (i.e., 1 ton of untreated K088 generates about 2 to 3 tons of treated residue).

Untreated potliners consist of approximately 2,766 mg/kg of cyanide based on a totals analysis. When treated samples were analyzed based on totals analysis, cyanide concentrations ranged from 50 mg/kg to 150 mg/kg. Leachable concentrations of treated samples at a 1:5 solid/liquid ratio ranged from 0.5 mg/L to 6.9 mg/L, and the pH values ranged from 12.5 to 12.8. At a 1:10 solid/liquid ratio, leachable concentrations of cyanide ranged from 0.2 mg/L to 1.5 mg/L, and pH values ranged from 12.3 to 12.5. Leachable values ranged from 0.2 mg/L to 2.5 mg/L, and pH values ranged from 11.9 to 12.6 at a 1:20 solid/liquid ratio. When comparing the average concentration of 76.7 mg/kg of total cyanide in treated samples, Reynolds' treatment process removes approximately 92 to 94% of cyanide from untreated potliner. The destruction of cyanide is determined in the same manner as the value for the removal of fluoride.

3.3 Ormet Primary Aluminum Corporation, Hannibal, Ohio

In 1996, Ormet Corporation began operation of its full-scale K088 treatment/recycling facility at its Hannibal, Ohio aluminum reduction plant. The plant uses technology developed by Vortec Corporation and applied to spent potliner.

Vortec Corporation, a research and development company founded in 1984 in Collegeville, PA, created an oxidation and vitrification process for remediation of soils, sludges, and sediments that have organic, inorganic, and heavy metal contamination.¹⁴ The Vortec process utilizes a combustion melting system (CMS™) process to recycle K088 into glass frit for applications in glass and ceramic finishing operations (24). The CMS™ consists mainly of a feed subsystem and a reaction and melting system that has the ability to oxidize and vitrify materials introduced as slurries, thus providing the capability of mixing waste oils, along with the hazardous soils. Typically, feedstock preparation includes crushing and grinding the spent potliner to minus 40 mesh required to ensure complete carbon oxidation and feedstock melting in the CMS™. In addition, Vortec adds various other glass-forming ingredients to the spent potliner to improve the melting characteristics of the spent potliner and to improve the physical/chemical properties of the vitrified product. The vitrification system process variables include system temperature and feedstock flowrate, where temperatures may range from 2000°F – 2700°F. Additional information on Vortec's CMS™ process was previously described in EPA's 1995 K088 BDAT Background Document using information principally obtained from Ormet's petition to the EPA requesting a delisting of their residues from this process (6).

Tables 3–2 and 3–3 summarize total and leachate data submitted by Vortec Corporation. These data represent additional analyses of treated waste from different K088 potliner sources. Table 3–2 presents total and amenable cyanide and total and TCLP levels of fluoride found in K088 waste managed by the Vortec process, and Table 3–3 presents data for one treated K088 sample analyzed by total TCLP, SPLP, and distilled water for fluoride and cyanide.

¹⁴Vortec Corporation produces patented operations at the leading edge in high temperature, waste processing and recycling technologies. Under a major contract with the U.S. Department of Energy, the company has also supplied its vitrification system for the processing of radioactive solid waste.

Table 3–2. K088 Treatment Data from Vortec

Constituent	Concentration in Treated Waste		
	Vortec Process	Ravensworth	Alumax
Cyanide (mg/kg)	Not analyzed	“Not detected” (1 data point; detection limit not provided)	<0.25 (7 data points)
Amenable cyanide (mg/kg)	Not analyzed	Not analyzed	Not analyzed
Total Fluoride (mg/kg)	2,900 to 26,000 (13 data points)	18,100 (1 data point)	5,400 to 20,500 (7 data points)
TCLP Fluoride (mg/L)	<0.001 to 10.3 (18 data points)	2 (1 data point)	0.3 to 10.3 (7 data points)

Reference: Vortec data: Letter from R.S. Compton, Kilpatrick Stockton LLP (Counsel for Vortec Corporation) to M. Goode, Office of Solid Waste, February 26, 1997 (23). Treated K088 waste from Vortec’s CMS™ process is compared to treatment performance data from aluminum production and management facilities Ravensworth and Alumax.

Table 3–3. K088 Treatment Data from Vortec Using Different Leaching Test Methods

Constituent	Concentration in Treated Waste			
	Total, mg/kg	TCLP, mg/L	SPLP	Distilled Water
Cyanide	<0.25	Not analyzed	Not analyzed	<0.005
Amenable cyanide	Not analyzed	Not analyzed	Not analyzed	Not analyzed
Fluoride	20,500	10.3	0.06	0.6
pH (final)	Not analyzed	Not analyzed	Not analyzed	8.3

Source: Letter from R.S. Compton, Kilpatrick Stockton LLP (Counsel for Vortec Corporation) to M. Goode, Office of Solid Waste, February 26, 1997 (Attachment C) (23). Treated K088 waste from Vortec’s CMS™ process.

The CMS™ process developed for the Ormet facility produces a nonhazardous reusable product with the qualities of industrial glasses. The process consists of a Counter Rotating Vortex (CRV) reactor, a cyclone reactor, and a separator/reservoir and involves the rapid suspension heating of the waste and other additives in a preheater prior to physical and chemical melting occurring within a cyclone reactor. The primary components of the process as applied to spent potliner management are feedstock preparation and the reaction/melting system.

Feedstock Preparation

Spent potliner (K088) is stored temporarily to allow for some drying. The K088 is then successively reduced in size from large chunks to a fine dust of approximately 40 mesh (0.4 mm particles). The spent potliner is heated with cyclone exhaust air to complete drying and stored in a hopper; the exhaust air is sent to a baghouse for particulate removal. This size reduction is required to ensure complete carbon oxidation and feedstock melting in the CMS™. The spent

potliner is mixed with various other glass-forming ingredients (sand and limestone) in a blender. This improves the melting characteristics of spent potliner and improves the physical/chemical properties of the vitrified product from spent potliner.

Reaction and Melting System

The remainder of the system consists of the CRV reactor, a cyclone melter, and a separator/reservoir. Fuel combustion and in-flight suspension preheating of the CMS™ process feedstock take place in a high combustion intensity CRV combustor. The feed (consisting of spent potliner and other glass forming ingredients) continuously flows into the CRV reactor. This is a refractory-lined vessel operating at a temperature of 2400°F using natural gas and air. The solids flow downward and begin the melting process, which is completed in the cyclone melter where the glass product is separated from the gas. The molten glass drops into a water quench tank, where the molten glass is solidified into glass frit. The frit is conveyed into a containment building and dropped onto a concrete pad. The gas is used to preheat the air for drying the spent potliner feed.

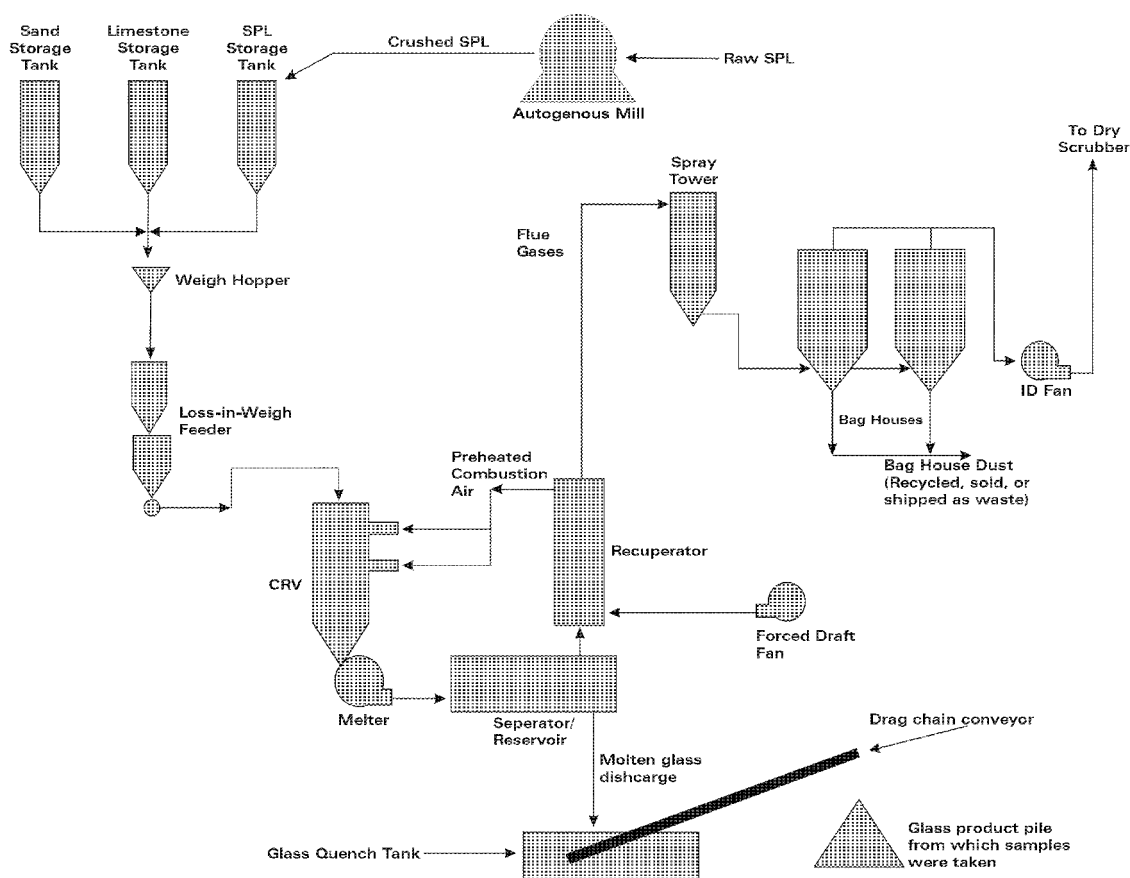
Exhaust gas from this process is sent to a recuperator, where natural gas combustion air is preheated, and the remaining flue gas leaves and enters the recuperator plenum, which is a water cooled carbon steel vessel. The gas then enters a spray tower and passes into a baghouse where particulate is removed. The air is then processed into an air pollution control device using alumina to dry scrub fluoride from the aluminum reduction pot exhaust gases. Any gaseous fluoride is removed and additional particulate removal proceeds. The material removed from the dry scrubber system is fluoride-enriched alumina. The fluoride-enriched alumina is charged back to the reduction pots. A portion of the baghouse dust is also charged back into the aluminum reduction pots as raw material to supplement the cryolite which consists of sodium aluminum fluoride. A larger portion, however, is sent off-site for reuse or recycle made available to the steel industry. Baghouse dust is generated at a rate of one ton per day, compared to a glass production rate of 22 tons per day (28).

Additional information gathered from a site visit regarding the process is presented in Appendix H; correspondence from Ormet regarding their process is included as Appendix K. Figure 3–2 presents a schematic of the CMS™ system.

Data Collection

In June 1999 EPA collected treatment performance data from the Ormet Aluminum Company in Hannibal, Ohio. These recent performance data represent full-scale treatment and, thus, differ from data previously obtained from Ormet and presented in the 1995 BDAT

Figure 3–2. Schematic of the ORMET CMS System



Reference: Ormet Corporation, *October 8, 1999 Memo* (28).

Background Document and 1998 NODA.¹⁵ Data from the full-scale treatment of the spent potliner were provided to EPA's Region 5, along with EPA Headquarters, to support the Agency's long-term strategy of amending the current K088 treatment standards. In evaluating sampling and analysis data, the Agency follows the guidance described in the *Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures and Methodology* (1).¹⁶

The CMS™ process in use at Ormet results in the generation of two residuals—a vitrified glass product and a baghouse dust. Samples of these two materials, as well as the untreated waste, were collected by Ormet on June 15, 1999. A detailed Sampling and Analysis Plan is located in Appendix I. The samples were collected as grab samples (i.e., a single sample of material was collected). The use of grab samples is preferred for EPA's BDAT program (1).

On June 15, the Agency collected four grab samples at two hour intervals during the hours of 8:00am to 4:00pm. Untreated potliner (i.e., influent) was sampled after being crushed into a fine powder but before being combined with sand and limestone to make glass. Also, four samples of the vitrified product were obtained during the same intervals. Each grab sample was taken from two shovel-fulls of frit, (or dry, powdery, nonleachable glass material) that were taken from the same spot, collected in a pile, and dumped in a tray, but not mixed.

These samples were sent to EPA's contract laboratory and analyzed accordingly for all constituents of concern:

¹⁵Ormet's K088 CMS™ treatment process changed from pilot- to full-scale treatment subsequent to EPA's 1995 rule. Data presented in the 1995 BDAT Background Document supporting the rule and in the 1998 NODA were based on Ormet's pilot-scale process data as part of Ormet's petition to delist residues from CMS™ treatment of K088 (6). Refer to the 1995 Background Document for a detailed description of the pilot-scale process and a presentation of Ormet's performance data.

¹⁶Only data from well-designed and well-operated facilities are acceptable as usable—a judgement made on a case-by-case basis for each set of potentially usable data. To be valid, all data must meet EPA's QA/QC standards. These requirements include, but is not limited to, documentation of basis for selecting sample point, documentation that SW-846 sample preservation procedures were followed, and documentation that chain-of-custody procedures were followed. Sample analysis data should include documentation of instrument calibration procedures, clearly-labeled results of blanks for field analysis, laboratory , and trips, matrix spike duplicates, detection limits, and documentation of quantitative results of all method-specific QC procedures for each sample reported.

- Total fluoride
- Leachable fluoride using (1) distilled water or (2) sodium hydroxide/water mixture at pH \approx 12.
- Total and amenable cyanide
- Arsenic (total [SW-846 Method 3052] and acid-soluble [SW-846 Method 3051])
- Leachable arsenic and other metals as determined by (1) TCLP, (2) TCLP modified to include ethylene diamine tetraacetic acid (EDTA), (3) California Waste Extraction Test (CA WET), (4) and CA WET modified by adjusting liquid to solid ratio and leaching duration.
- Total polynuclear aromatic hydrocarbons
- Percent moisture/solids
- pH

A summary of these analyses are provided in Table 3-4. A summary of the laboratory results for cyanide and fluoride are provided in Table 3-5, while a complete summary of data results for all constituents of concern, as well as arsenic, that includes MS/MSD and QA/QC data can be found in Appendix D. In a similar manner, four samples each of untreated waste and vitrified product, along with baghouse dust, were collected on June 22, 1999. The data and laboratory results from this second day of sampling were excluded from the sample analysis presented in this section, but are presented in Appendix F.

Table 3–4. Summary of Laboratory Analyses

Parameter	Method	Target Method Detection Limit ¹	Precision ¹ (%RPD)	Accuracy ¹ (%R) Warning Limits	Accuracy ¹ (%R) Acceptance Limits	Completeness ¹
Total Fluoride ⁴	SM 4500–F/SW–846 Method 9056	5 mg/kg ²	< 25%	50–125%	25–150%	90%
PAHs ⁵	SW–846 Method 8270B	330 µg/kg ²	< 25%	50–125%	25–150%	90%
Total Arsenic	SW–846 Method 3052/6010B	1 mg/kg ²	< 25%	50–125%	25–150%	90%
Total Acid- Soluble Arsenic	SW–846 Method 3051/6010B	1 mg/kg ²	< 25%	50–125%	25–150%	90%
Total Cyanide	SW–846 Method 9010B	1 mg/kg ²	< 25%	50–125%	25–150%	90%
Total Amenable Cyanide	SW–846 Method 9010B	1 mg/kg ²	< 25%	50–125%	25–150%	90%
pH	SW–846 Method 9045C (Soil pH)	NA	< 25%	NA	NA	90%
Percent solids/ moisture ⁶	—	NA	< 25%	NA	NA	90%
TCLP ⁷	SW–846 Method 1311	NA ³	< 25%	50–125%	NA	90%
EDTA TCLP ⁸	SW–846 Method 1311	NA ³	< 25%	50–125%	NA	90%
Leachable Fluoride	ASTM D3987	10 µg/L	<25%	50–125%	25–150%	90%
Modified Leachable ⁹ Fluoride	ASTM D3987	10 µg/L	<25%	50–125%	25–150%	90%
CA WET Metals ¹⁰	CA Waste Extraction Test	NA ³	<25%	50–125%	25–150%	90%
Modified CA WET Metals ¹¹	CA Waste Extraction Test	NA ³	<25%	50–125%	25–150%	90%

¹Site-specific values will be developed from knowledge of the waste.

²Detection limits are specific to individual target analytes and the matrix sampled.

³Arsenic measurements must achieve detection limits of 0.01 mg/L or better.

⁴Due to the high levels of fluoride expected in at least one sample matrix, the laboratory was given the option of reducing the sample size suggested for analysis.

⁵PAH compounds include: acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

⁶Percent solids is determined by drying a sample in an oven at 60°C and weighing the residue.

⁷For the K088 samples, the resulting leachate was analyzed for antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

⁸A modification of SW–846 Method 1311 can be followed for Modified TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. In place of the acetate buffer, a 0.1 M EDTA solution at pH 5 is used as the leaching fluid. The resulting leachate was analyzed for the metals previously mentioned.

⁹The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste can also be determined using a modification of ASTM D3987 in which the leaching fluid is prepared using a NaOH solution at pH 11.5 to 12.5, in place of reagent water.

¹⁰The California Wet Extraction Test (CA WET) is performed for metals leachability testing. With this analysis, sample are generally tumbled in a 10:1 buffer solution of 0.2M sodium citrate for 48 hours. The resulting K088 leachate was analyzed for antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

¹¹A modified CA WET can also be performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The modification includes a 20:1 liquid to solid ratio with an 18 hour leaching period. The resulting leachate was for the same constituents mentioned previously.

Table 3–5. Data Summary Based on Analytical Results from Samples on June 15, 1999

Ormet Corporation, Hannibal, OH Facility	Reported Concentration (mg/kg)		Total Concentration Used ^a	Matrix Spike Recovery (%)	Matrix Spike Duplicate Recovery (%)
	Sample	Duplicate			
Amenable Cyanide					
Glass for USEPA 1	<0.5	<0.5	0.5	0	0
Glass for USEPA 2	<0.5	not given	0.5	—	—
Glass for USEPA 3	<0.5	not given	0.5	—	—
Glass for USEPA 4	<0.5	not given	0.5	—	—
Spent Pot Liner 1	421	not given	n/a	—	—
Spent Pot Liner 2	281	not given	n/a	—	—
Spent Pot Liner 3	303	not given	n/a	—	—
Spent Pot Liner 4	282	293 ^b	n/a	—	—
Percent Recovery 99.86%					
Total Cyanide					
Glass for USEPA 1	<0.5	not given	0.5	—	—
Glass for USEPA 2	<0.5	not given	0.5	—	—
Glass for USEPA 3	<0.5	not given	0.5	—	—
Glass for USEPA 4	<0.5	<0.5	0.5	108.7	109.3
Spent Pot Liner 1	714	not given	n/a		
Spent Pot Liner 2	578	not given	n/a		
Spent Pot Liner 3	690	not given	n/a		
Spent Pot Liner 4	707	729 ^b	n/a		
Percent Recovery 99.93%					
Leachable Fluoride					
Glass for USEPA 1	1.90	1.80	1.90mg/L	110	110
Glass for USEPA 2	2.30	not given	2.30mg/L	—	—
Glass for USEPA 3	1.90	not given	1.90mg/L	—	—
Glass for USEPA 4	2.50	not given	2.50mg/L	—	—
Spent Pot Liner 1	3,210	not given	n/a	—	—
Spent Pot Liner 2	3,000	3,030 ^b	n/a	104	105
Spent Pot Liner 3	3,070	not given	n/a	—	—
Spent Pot Liner 4	3,230	not given	n/a	—	—
Percent Recovery 99.93%					
Total Fluoride ^c					
Glass for USEPA 1	33.90	32.20	33.90mg/kg	94.0	81.0
Glass for USEPA 2	41.80	not given	41.80mg/kg	—	—
Glass for USEPA 3	40.90	not given	40.90mg/kg	—	—

Table 3–5. Data Summary Based on Analytical Results from Samples on June 15, 1999

Ormet Corporation, Hannibal, OH Facility	Reported Concentration (mg/kg)		Total Concentration Used ^a	Matrix Spike Recovery (%)	Matrix Spike Duplicate Recovery (%)
	Sample	Duplicate			
Glass for USEPA 4	37.40	not given	37.40mg/kg	–	–
Spent Pot Liner 1	66,400	not given	n/a	–	–
Spent Pot Liner 2	69,600	not given	n/a	–	–
Spent Pot Liner 3	57,700	not given	n/a	–	–
Spent Pot Liner 4	57,400	not given	n/a	–	–
Percent Recovery 99.94%					

^aTotal Concentration Used indicates the actual number used in calculations of the treatment standard. According to the QA/QC Background Document, where duplicates are provided, the higher of the two values is used in the actual treatment standard calculation. Where there were “less than” values given, EPA used the maximum number given (i.e., where raw data reported as <2, total concentration used is 2.00). Also, concentrations were rounded to two decimal places.

^b Duplicate values for total amenable cyanide, total cyanide, and leachable fluoride in the untreated waste were not used in any of the calculations summarized in the text.

^c Total fluoride sample results were based on a total acid soluble process that requires sample preparation with heated acid distillation. A less rigorous analysis was also performed; for the total soluble fluoride analysis, sample preparation was completed with a 1:1 mixture of distilled water. These results are presented in Appendix D.

Notes:

“n/a” indicates that provided data were not used in this analysis.

“not given” indicates that the data was not provided in the laboratory report.

Total cyanide and amenable cyanide concentrations were measured using SW–846 Method 9010B. Total cyanide concentrations in untreated samples ranged from 578 mg/kg to 714 mg/kg, while treated concentrations were <0.5 mg/kg. Amenable cyanide concentrations in untreated samples ranged from 281 mg/kg to 421 mg/kg. Treated samples were all non-detect, < 0.5 mg/kg. The average concentrations of total and amenable cyanide were calculated as 672.25 mg/kg and 321.75 mg/kg in untreated spent potliner, respectively, and 0.50 mg/kg in the treated glass product.

For total fluoride based on the distilled sample preparation using heated acid distillation, SM 4500–F/SW–846 Method 9056 untreated samples had concentrations ranging from 57,400 mg/kg to 69,600 mg/kg, and concentrations in treated samples ranged from 33.9 mg/kg to 41.8 mg/kg. Leachable fluoride concentrations were measured using the ASTM D3987 procedure and ranged from 3,000 mg/L to 3,230 mg/L in untreated spent potliner samples, and 1.9 mg/L to 2.5 mg/L in treated, glass residue. The average concentration of total fluoride was calculated as 62,775 mg/kg in untreated spent potliner and 38.50 mg/kg in the treated glass product. Leachable

fluoride concentrations averaged 3,128 mg/L in untreated samples and 2.15 mg/L in treated samples.

Not shown in Table 3–5, leachable concentrations of fluoride were also measured using a modified leachable testing method, where a leaching fluid of NaOH at a pH of 11.5 to 12.5 is used in place of reagent water to prepare the sample. This analysis was performed to better predict the leachability of the glass frit in high alkaline conditions thought to develop in landfills. At a final pH of 12.32, leachable fluoride concentrations measured 1.8 mg/L and 2.1 mg/L. At a final pH of 12.33, leachable fluoride concentration measured 2.1 mg/L, and leachable concentration measured 2.0 mg/L at a final pH of 12.28. These leachable concentrations are very similar to leachable concentrations measured with the distilled water preparation at moderate pH levels. At a final pH of 9.27, leachable concentration measured 2.3 mg/L, and at a final pH of 8.97, leachable concentration measured 2.5 mg/L. A leachable concentration of 1.9 mg/L was measured with both 8.43 and 8.0 pH values. In comparison, the values of leachable concentration remain the same when present in solutions of moderate pH and high pH. Therefore, if the treated residue, or glass frit, were disposed in high alkaline landfills, the glass frit would most likely maintain its current composition of fluoride. Appendix D presents these fluoride concentrations and pH values.

Evaluating untreated spent potliner and the treated glass residue, the system removes approximately 99.86 % amenable cyanide and 99.93% total cyanide. The system also removes approximately 99.93% leachable fluoride and 99.94% total distilled fluoride.

Compared to the industry characterization analysis, shown in Table 2–2, Ormet generates K088 with average concentrations of constituents of concern that are within the range of other facilities. Specifically, Ormet’s K088 contains average cyanide concentrations of 673 mg/kg based on totals analysis. Common industry concentrations range from 18.5 mg/kg to 9,190 mg/kg. Ormet’s older waste characterization data in Table 2-2 showed cyanide concentrations ranging from 840 mg/kg to 2,400 mg/kg. Fluoride concentrations range from 230 mg/kg to 135,000 mg/kg in common industry practices. Ormet’s older waste characterization data in Table 2-2 showed fluoride concentrations ranging from 73,000 mg/kg to 110,000 mg/kg, with newer

sampling data from Table 3-5 showing concentrations ranging from 57,400 mg/kg to 69,600 mg/kg.

3.4 Treatment Standards Development for Cyanide and Fluoride

In the development of revised treatment standards for total cyanide, amenable cyanide, and fluoride, the Reynolds' process is compared to the Ormet CMS™ process in Table 3-6.

In comparison, the Ormet CMS™ process generates lower concentrations of cyanide, fluoride, and other metal constituents in the treated potliner through destruction, recovery, and immobilization when compared to the Reynolds' technology. As shown in Table 3-1, the Reynolds treated residue contains average concentrations of 44,678 mg/kg and 552 mg/L total and leachable fluoride, respectively.¹⁷ The CMS™ process generates leachable fluoride at an average 2.15 mg/L in treated potliner (as shown in Table 3-5). Total fluoride analysis shows that the Ormet process generates an average of 38.5 mg/kg fluoride in treated potliner. Cyanide levels average 76.7 mg/kg for total analysis, and 0.95 mg/L for leachable analysis in the Reynolds residue. The Ormet process generates an average 0.50 mg/kg cyanide in the treated glass product.

¹⁷ Reynolds data in Table 3-1 refer to results at a solid to liquid ratio of 1 to 20.

Table 3-6. Summary Comparison of the Ormet and Reynolds Processes Used to Treat K088

Company	Technology	Scale	Process Summary, Raw Materials, and Residuals	Fate of K088 BDAT Contaminants
Ormet Primary Aluminum Corporation, Hannibal Ohio	Combustion Melting System (CMS™)	Full scale processing of Ormet's K088 only; capacity of 7,000 tons per year of K088.	The K088 is fed with sand and limestone to a CMS™ process to melt, or vitrify, the raw materials at 2400 °F. Products and residuals of the process include the vitrified material (or glass frit) and air pollution control wastes consisting of baghouse dust and dry scrubber residue.	Cyanide, PAHs: destroyed by heat. Cyanide destruction is above 99.9%. ^a Arsenic: available data indicate arsenic partitions to baghouse dust rather than to vitrified material, but data are for K088 with relatively low arsenic. Fluoride: Volatilizes and removed in air pollution control wastes. Fluoride removal is above 99.9%. ^a
Reynolds Metals Company, Gum Springs Arkansas	Rotary kiln thermal treatment	Full-scale commercial process, capacity of 120,000 tons per year of K088.	The K088 is fed with red clay sand and limestone to a rotary kiln, operated at 1200 °F. The process generates the treated residue and an air pollution control waste, electrostatic precipitator dust.	Cyanide, PAHs: destroyed by heat. Cyanide destruction is 92 to 94%. ^b Arsenic, fluoride: fixed in kiln residue. Fluoride removal is 0%. ^b

Reference (6, 11).

^a Destruction of cyanide and removal of fluoride by Ormet process was calculated using the data in Table 3-5 (i.e., average concentration in treated residue divided by the average concentration in the untreated waste).

^b Destruction of cyanide and removal of fluoride by Reynolds process was calculated using the data in Table 3-1 (i.e., average concentration in treated residue divided by the average concentration in the untreated waste, multiplied by a factor of 2 to 3 to account for the addition of sand and limestone— 1 ton of untreated K088 generates about 2 to 3 tons of treated residue.

Percent removal values of treated fluoride and cyanide for Ormet, summarized in Table 3-6, show that the process recovers more fluoride compared to the Reynolds' process, as well as having greater cyanide removal efficiency.

The Ormet treatment facility has established a reuse practice of recycling the fluoride-rich alumina, created from the baghouse.¹⁸ Finally, Ormet's CMS™ process generates glass frit that contains the hazardous constituents, in particular fluoride, independent of pH values, and is

¹⁸The Ormet CMS™ process generates baghouse dust that can be recycled or sent off-site for beneficial reuse. Specifically, a portion of the baghouse dust is charged back to the aluminum reduction pots as raw material to supplement the cryolite which consists of sodium aluminum fluoride. A larger portion of the baghouse dust is also sent off-site as product to the steel industry, while other potential customers are being reviewed. Previously, however, some of the baghouse dust was sent off-site for land disposal according to CBI documentation.

suitable for land disposal.¹⁹ Therefore numerical, concentration-based treatment standards for total cyanide, amenable cyanide, and fluoride, are based on data for the CMS™ process in operation at the Ormet facility.²⁰ A revised treatment standard for fluoride will be based on concentrations measured according to a distilled water leaching method (i.e., a leachable metals test, ASTM D3987, performed using distilled water as a leaching fluid), and the proposed treatment standards for total cyanide and amenable cyanide will be based on analysis performed according to SW-846 Method 9010. As shown in Table 4–2 of the following section, Ormet’s CMS™ process also results in minimum concentrations for the other 23 constituents, including other toxic metals, as well as PAHs, that meet the current treatment standards.

3.5 Ability of Ormet Process to Treat K088 from Other Sources

Ormet’s CMS™ process has been demonstrated to treat K088 generated at Ormet’s Hannibal Ohio facility. However, K088 is generated throughout the U.S. with levels of contaminants varying from plant to plant as well as over time. As such, the composition of K088 generated and treated at Ormet is necessarily different than the composition of K088 generated at other aluminum reduction facilities throughout the U.S.

Table 2–2 reviews some of the available data characterizing K088 generated at various aluminum reduction facilities nationwide. Although it does not comprehensively identify the characteristics of K088 by every generator, it includes 7 of the 23 domestic generators of K088, including plants located throughout the country and operated by different corporations.

¹⁹The Agency received laboratory results from a leachable fluoride analysis that measured leachable fluoride concentrations at an initial pH value of approximately 12 using a buffer solution at 11.5 to 12.5pH. This analysis was performed to better predict the leachability of the glass frit in high alkaline conditions thought to develop in landfills. Appendix D presents these fluoride concentrations and pH values.

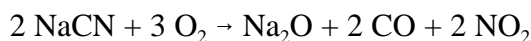
²⁰The Agency notes that when it establishes concentration-based treatment standards, the regulated community may use any non-prohibited technology to treat the waste to meet the treatment standards. Compliance with concentration-based treatment standards requires only that the effluent concentration be achieved; once achieved, the waste may be land disposed. Any treatment, including recycling or any combination of treatment technologies, unless prohibited (e.g., impermissible dilution) or unless defined as land disposal (e.g., land treatment), can be used to achieve these standards.

3.5.1 Cyanide

The Ormet sampling data in Table 3–5 show K088 to have cyanide levels ranging from 580 to 730 mg/kg. These data were from the sampling results used in calculating the treatment standards described in Section 4 of this report. Table 2–2 presents K088 cyanide characterization data for seven other generators of K088; the total cyanide levels range from 19 to 9,200 mg/kg. EPA concludes from these data that the cyanide content of Ormet’s waste is at the low to mid point of a national distribution. Therefore, even though the cyanide levels in the glass residue were not detected (with a detection limit of 0.5 mg/kg), one might be tempted to conclude that Ormet’s waste is not the most difficult to treat for cyanide. However, based on EPA’s review of the Ormet process EPA concludes that the process can treat much higher levels of cyanide even in the absence of K088 performance data.

In support of its delisting petition prepared by Ormet in 1994, Ormet provided performance data for its then pilot scale process to treat K088. K088 with cyanide levels up to 2,400 mg/kg were treated to below detection limit (<1 mg/kg) on four of five operating days (6). Although the data are from a pilot-scale process, the data show that K088 with cyanide levels higher than those found in the 1999 sampling (i.e., 730 mg/kg vs. 2,400 mg/kg) can be treated to below detection. EPA has reason to believe that even higher levels of cyanide can also be treated to below detection. Specifically, two factors are expected to contribute to greater destruction efficiency in the Ormet process than in the Reynolds process. These factors are the higher temperatures and smaller particle size used in the Ormet process. Other operational factors also contribute to favorable destruction of cyanide in the Ormet process.

The Reynolds process operates at approximately 1200°F (650°C) while the Ormet process operates at approximately 2400°F (1320°C). Reaction temperature has a strong effect on reaction kinetics, or the speed at which a reaction takes place. Specifically, sodium cyanide present in the waste is expected to react in either the Reynolds or the Ormet process according to the following reaction (25):



In reactions such as this one, the reaction speed increases as temperature increases. Although the reaction kinetics of the above reaction have not been documented in the literature, specific study has been made with other reactions involving cyanide and oxygen at elevated temperatures. For the reaction of the cyanide radical ($\text{CN}\cdot$) with oxygen, the reaction rate constant was found to be about ten percent lower at the temperatures used in Ormet's process (29). This indicates that, all things being equal, the reaction would proceed faster at the higher temperature in the Ormet process than in the Reynolds process. This would contribute to an enhanced ability for the Ormet process to destroy cyanide compounds.

The Ormet process uses smaller sized waste as feed (0.4 mm) than does the Reynolds process (9 mm). The use of smaller particles in the Ormet process is expected to provide several benefits in terms of cyanide destruction. First, heat will more readily penetrate a smaller particle than a larger one. This allows the particle to reach the surrounding reactor temperature in a shorter amount of time and allow reaction to take place at the faster rates shown above. Secondly, gases will more easily penetrate a smaller particle than a larger one, which allows for faster movement of the co-reactant oxygen into the particle, and faster movement of reaction products out of the particle.

Several other factors are expected to contribute to cyanide destruction in the Ormet process (these factors are not compared to the Reynolds process). First, the mixing and storage of the waste prior to heating allows for equalization of localized, high levels of cyanide in the feed. The waste is ground and then transported to first a 350 ton capacity tank, and then a 2000 cubic foot (approximately 75 ton) silo. Each of these containers is sized well above a typical size of a single pot (7 tons).

Second, the Ormet process uses high inlet velocity gas (i.e., oxygen and fuel) in conjunction with the solid particles. In general, high velocities will enhance the speed at which a reaction takes place, because the mass transfer resistance is lower. This allows the oxygen (a reaction co-reactant) to more easily penetrate the particle. This feature of the Ormet process is expected to contribute favorably to cyanide destruction.

As a result of the additional pilot scale data for cyanide destruction presented above, the comparisons of several facets of the Ormet process versus the Reynolds process, and other cyanide destruction factors present in the Ormet process, EPA is confident that higher concentrations of cyanide (such as those encountered by Reynolds as well as other generators of K088) will be destroyed by this process.

3.5.2 Fluoride

The Ormet sampling data in Table 3–5 show K088 to have total fluoride levels ranging from 5.7 to 7.0 percent. These data were from the sampling results used in calculating the treatment standards described in Section 4 of this report. Table 2–2 presents K088 fluoride characterization data for seven other generators of K088; the total fluoride levels range from 0.7 to 13.5 percent. EPA concludes from these data that the fluoride levels from Ormet’s K088 are near the mid point of a national distribution, but not representative of a worst case.

Nevertheless, EPA expects that the Ormet process can treat K088 with higher levels of fluoride. The high temperatures of the process, coupled with the small particle size, promotes volatilization of the fluoride from the waste such that the fluoride is removed from the glass residue.

3.5.3 Organic Components

For the reasons given above for cyanide destruction, EPA expects polycyclic aromatic hydrocarbons (PAHs) will also be destroyed in this process, independent of their initial concentration in the untreated potliner. Analytical data for Ormet’s untreated K088 and the glass residue show PAHs not detected in both cases (see Appendix D). Therefore, EPA can not make a quantitative comparison between PAHs in Ormet’s waste and PAHs in wastes from other K088 generators.

4.0 TREATMENT STANDARD CALCULATIONS FOR CYANIDE AND FLUORIDE

4.1 Numerical Treatment Standard Development for Cyanide and Fluoride

As shown in Chapter 3, the Ormet process generates treatment residue with concentrations of cyanide and leachable fluoride lower than the Reynolds process, as well as the treatment system employed at CWMNW. Ormet's performance data show that cyanide destruction values exceed those values obtained from Reynolds (and CWMNW), and the fluoride recovered from the treatment process is vaporized for later reuse and is effectively immobilized.²¹ In the Reynolds process, the fluoride remains in the residue in a less mobile state. The Ormet process, like the Reynolds process, operates at full-scale (i.e., it is demonstrated). For these reasons Ormet's process was selected as representing 'best demonstrated available technology' and were used in calculating revised numerical treatment standards for cyanide and fluoride. Specifically, treatment standard calculations for amenable cyanide, total cyanide, and leachable fluoride in nonwastewater forms of K088 are based on performance data from EPA sampling on June 15, 1999. These data, representing four grab samples of waste, are summarized in Table 3-4 for these constituents. The complete data are presented in Appendix D.

EPA is presenting calculated treatment standards for: total cyanide; amenable cyanide; leachable fluoride as measured by a distilled water leaching procedure (where distilled water is used as the leaching fluid in the TCLP); and total fluoride.²² In calculating these treatment standards, the Agency relies on guidance presented in the *Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures*

²¹The Ormet process is capable of providing efficient recovery and immobilization of fluoride regardless of concentrations found in untreated potliner. A large portion of the fluoride is partitioned to the vitrification baghouse dust, and is, therefore, recoverable. The remainder of the fluoride is immobilized in glass-frit, which meets all treatment standards identified in CFR 268.40 for K088 waste.

²²As shown in Appendix D, other fluoride parameters were analyzed including leachable fluoride as measured by an alkaline leaching procedure (where an alkaline solution is used as the leaching fluid in the TCLP), and total distilled fluoride. The data for the total distilled fluoride were not evaluated further because of poor matrix spike and matrix spike duplicate results (refer to the raw data in Appendix D). The data from the alkaline leaching procedure were comparable to the data resulting from the distilled water leaching procedure (see Appendix D and Section 3).

and Methodology (1). The steps in the process are presented below:

- **Outlier Analysis:** An outlier in a data set is an observation (or data point) that is significantly different from the other data. The measure of difference is determined by the statistical method known as a Z-score. Data with a Z-score outside the range of -2.0 to 2.0 are considered to be outliers and are discarded.
- **Determination of Accuracy Correction Factor:** The accuracy correction factor adjusts laboratory results for accuracy, based on the laboratory test's "recovery value" for each constituent analyzed. The recovery value measures the amount of constituent recovered after "spiking"—the addition to the waste sample of a known amount of constituent.
- **Determination of Variability Factor:** The variability factor takes into consideration fluctuations in performance in well-designed and well-operated systems that may be caused by variations in influent concentrations, procedures for collecting samples, and variations in sample analysis.
- **Calculation of the Numerical Treatment Standard.**

4.1.1 Outlier Analysis

The Agency evaluated facility data using a Z-score analysis, as described in the QA/QC Background Document. For each cyanide and fluoride data set, a Z-score analysis was performed to determine any outliers within the data set. The Z-score analysis is based on the following formula:

$$\text{Z-score} = \frac{\ln[\text{Data Point Value}] - \ln[\text{Average}]}{\ln[\text{Standard Deviation}]}$$

According to the QA/QC Background Document, for data that are normally distributed, 99.5 percent of the measurements will have a Z-score between -2.0 and 2.0. Any data point outside this range is not considered to be representative of the population from which the data points are drawn. There were no outliers shown within any of the four data sets. Graphs showing the z-scores results are presented in Figures 4–1 through 4–4. Calculations of the data points are noted, along with detailed calculations of treatment standards, in Appendix E.

Figure 4-1. Z-score Analysis for Amenable Cyanide

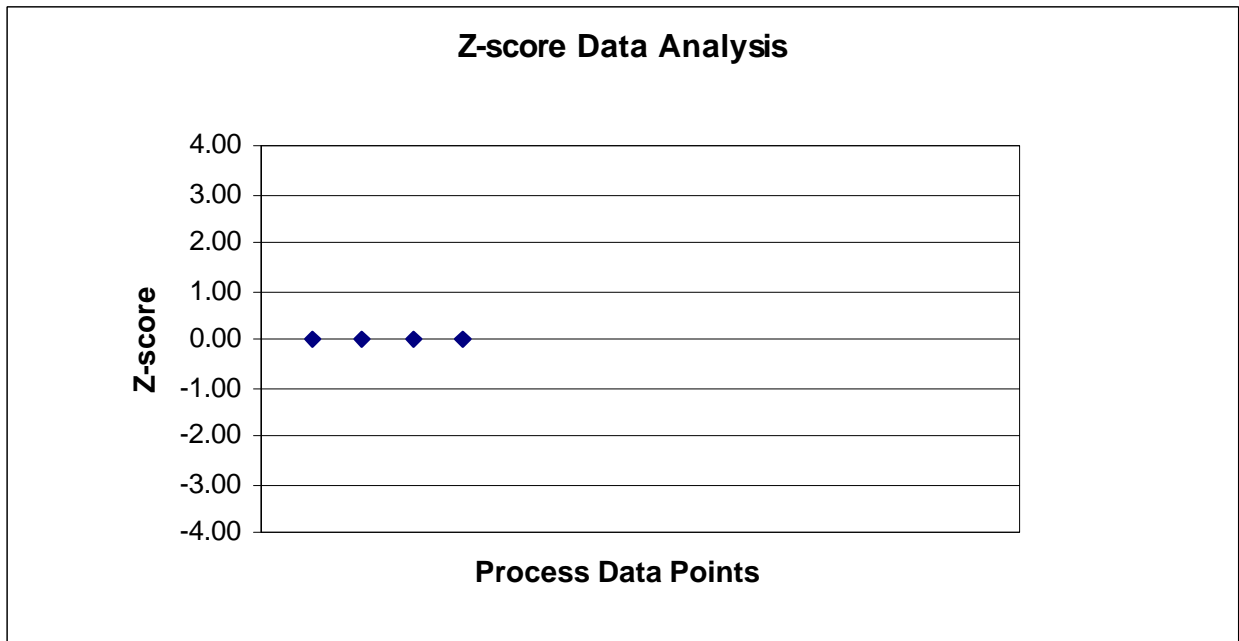


Figure 4-2. Z-score Analysis for Total Cyanide

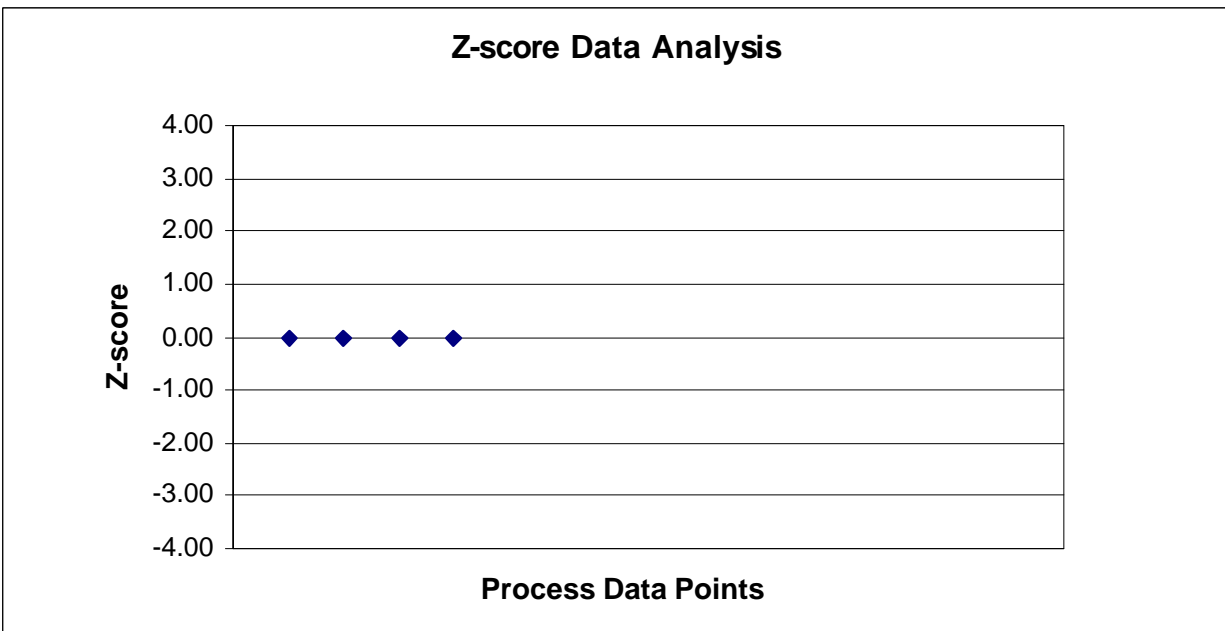


Figure 4–3. Z-score Analysis for Leachable Fluoride

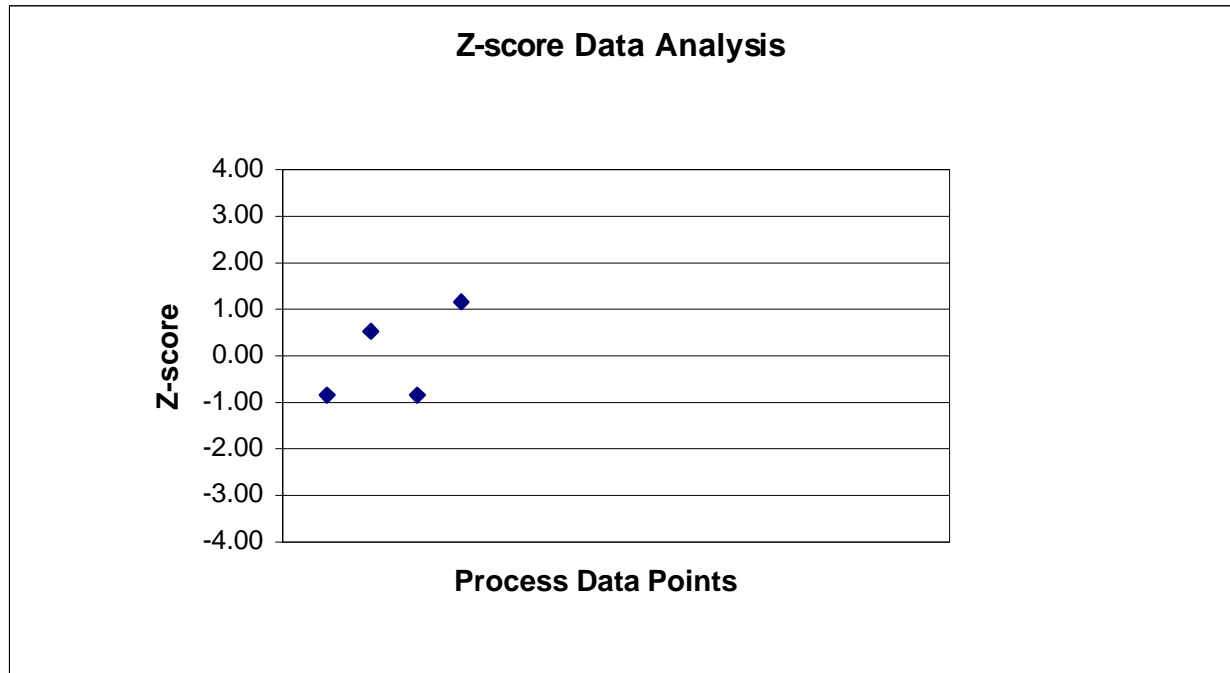
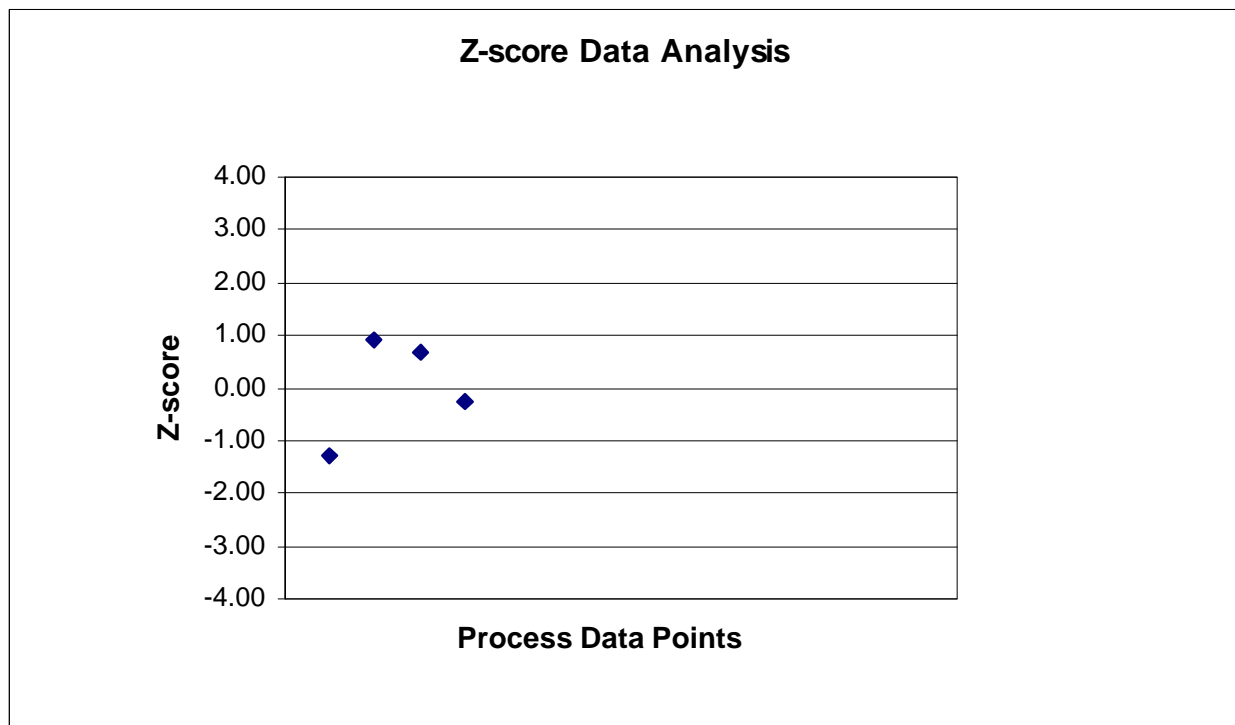


Figure 4–4. Z-score Analysis for Total Fluoride



4.1.2 Accuracy Correction Factor (ACF)

To calculate treatment standards, it is necessary to adjust laboratory results for accuracy, based on the laboratory test's "recovery value" for each constituent. The recovery value measures the amount of constituent recovered after "spiking" (the addition to the waste sample of a known amount of constituent). The recovery value is equal to the amount of constituent recovered after spiking, minus the initial concentration in the sample, divided by the amount recovered.

The accuracy correction factor, $ACF = \frac{1.0}{\% \text{ recovery value}^*}$

* The % recovery value is determined by the lowest acceptable percent recovery value evaluated within the entire data set.

The calculation of the accuracy correction factors are presented in Appendix E. The results of that analysis are as follows:

- ACF for total cyanide: 0.92
- ACF for amenable cyanide: 1.0
- ACF for leachable fluoride (distilled water analysis): 0.91
- ACF for total fluoride: 1.23

4.1.3 Variability Factor (VF)

The methodology for calculating the variability factor is described in the QA/QC Document. The variability factor provides an estimate of the daily maximum variability determined from a sample population of daily data. It is calculated as shown below:

The variability factor, $VF = \frac{C_{99}}{\text{Mean}}$

where,

C_{99} = Estimate of performance values for which 99 percent of the daily observations will be below. C_{99} is calculated using the following equation: $C_{99} = \text{Exp}(y + 2.33 S_y)$, where y and S_y are the mean and standard deviation, respectively, of the logtransformed data.

Mean = Average of the individual performance values.

In cases where all samples are reported as not detected, the variability factor is assigned a value of 2.8. The calculation of the variability factors are presented in Appendix E. The results of that analysis are as follows:

- VF for total cyanide: 2.8
- VF for amenable cyanide: 2.8
- VF for leachable fluoride (distilled water analysis): 1.37
- VF for total fluoride: 1.25

4.1.4 Treatment Standard Calculations

The final step in calculating the treatment standard is multiplying the average treatment value observed in the acceptable available data by the accuracy correction factor and the variability factor:

$$\text{Treatment Standard} = \text{ACF} \times \text{Average Concentration} \times \text{VF}$$

Table 4–1 provides data results for the cyanide and fluoride treatment standard calculations. Details of these calculations are shown in Appendix E.

Table 4–1. Summary of Treatment Standards Calculated from Data of Glass Residue

Constituent	Average Concentration of all four samples	Variability Factor	Accuracy Correction Factor	Calculated Treatment Standard
Total Cyanide	0.50 mg/kg	2.80	0.92	1.4 mg/kg ^a
Amenable Cyanide	0.50 mg/kg	2.80	1.00	1.4 mg/kg ^a
Total fluoride	38.50 mg/kg	1.25	1.23	59 mg/kg
DI Water leachable fluoride	2.15 mg/L	1.37	0.91	2.7 mg/L

Treatment standard is calculated by multiplying the average concentration times the variability factor times the accuracy correction factor. The accuracy correction factor is the inverse of the lowest matrix spike recovery (not shown on this table).

^a Generally, concentrations for amenable cyanide are less than or equal to those for total cyanide. In this case, according to actual laboratory results, the concentrations of amenable and total cyanide were both 0.50 mg/kg.

The accuracy correction factor, which is multiplied with the actual concentration in the calculation of the treatment standard, was 1.00 for amenable cyanide and 0.92 for total cyanide; therefore, the calculated treatment standard concentration of the amenable cyanide was 1.4 mg/kg and total cyanide was 1.3 mg/kg. However, to resolve any compliance issues, we have proposed the same treatment standard concentration for both amenable and total cyanide. Refer to Appendix E to review detailed calculations of the standards.

Existing treatment standards for K088:

Total cyanide: 590 mg/kg

Amenable cyanide: 30 mg/kg

Fluoride: no current standard. Formerly 48 mg/L using the TCLP.

4.2 Ability of Ormet and Reynolds to Meet Proposed Treatment Standards

Both the Reynolds and Ormet processes generate nonwastewater forms of K088 that would have to meet the standards calculated in the previous section for fluoride (as measured by distilled water extraction), cyanide (total), and cyanide (amenable). Available performance data are available from each system, and these data are evaluated statistically to determine if the process would be expected to meet the standard.

In summary, evaluation of cyanide and fluoride data shows that the Reynolds process generally can not achieve the proposed treatment standards, while the Ormet process generally can achieve the proposed treatment standards.

4.2.1 Reynolds Process

The latest available data from Reynolds are cited in the August 1998 Notice of Data Availability (63 FR 41536, August 4, 1988). These include total arsenic data from late 1997 using their current process (i.e., with red clay sand as a raw material, rather than the brown sand), as well as data for six points of cyanide and fluoride from December 1996. These are reproduced in Table 3-1.

Statistical analysis of the December 1996 data for cyanide and fluoride show that Reynolds would not be able to meet the proposed standards more than 99 percent of the time. Specifically, using a lognormal transformation of the data, the 1st quantile of the data set was found to be above the relevant proposed treatment standard. Because this analysis is based on

only six data points, additional data were taken from the record. Reynolds had previously made available additional data for total cyanide as part of the record for the January 1997 final rule. These include 21 samples analyzed for total cyanide from November 1996 to April 1997. Analysis of this data, using a lognormal transformation, again show that the 1st quantile of the data set was above the relevant proposed treatment standard of 1.4 mg/kg. These calculations are described in Appendix J.

While analyses of these data indicate that the Reynolds process is unlikely to meet the proposed treatment standards (i.e., 99 percent of the time it would not meet the standard), there is uncertainty because these data are were generated prior to, or during, their change from brown sand to red clay sand. Reynolds may have more recent data showing significantly lower concentrations of cyanide and leachable fluoride in the treated residue.

4.2.2 Ormet Process

The most relevant data from Ormet are from the four samples collected during their June 15, 1999 sampling event and presented in Table 3–5. The glass frit residue was evaluated to determine how well it would comply with the proposed treatment standard.

Statistical analysis for total cyanide and amenable cyanide is not possible. None of the samples had detectable levels of cyanide, above 0.5 ppm. (This is below the proposed standards of 1.4 mg/kg for total and amenable cyanide).

Using a lognormal transformation of the data for leachable fluoride, the 95th quantile of the data set was found to be equal to the relevant proposed treatment standard. Therefore, glass frit generated from the Ormet process would be expected to meet the fluoride standard in 95 percent of the cases. These calculations are described in Appendix J. An uncertainty with this analysis is that it is based only on four data points, which are assumed to be representative of the generated glass frit.

Table 4–2 compares data from Ormet’s process to the proposed or existing numerical treatment standards applicable to nonwastewater forms of K088. Table 4–2 presents the maximum of four values of residual glass frit generated from Ormet’s process. Table 4–2 shows that residual glass frit generated from Ormet’s process would meet the existing K088 treatment standards as well as the proposed treatment standards for cyanide and fluoride.

Table 4–2. Comparison of Concentrations in Ormet Residual Glass Frit to K088 Treatment Standards

Constituent of Concern	Maximum Ormet Concentration	Proposed or Existing Numerical Standard
Fluoride (proposed standard)	2.5 mg/L D.I.	2.7 mg/L D.I.
Cyanide (proposed standard)	<0.5	1.4 mg/kg
Cyanide (amenable) (proposed standard)	<0.5	1.4 mg/kg
Acenaphthene	<0.33	3.4 mg/kg
Anthracene	<0.33	3.4 mg/kg
Benz(a)anthracene	<0.33	3.4 mg/kg
Benzo(a)pyrene	<0.33	3.4 mg/kg
Benzo(b and k)fluoranthene	<0.33	6.8 mg/kg
Benzo(g,h,i)perylene	<0.33	1.8 mg/kg
Chrysene	<0.33	3.4 mg/kg
Dibenz(a,h) anthracene	<0.33	8.2 mg/kg
Fluoranthene	<0.33	3.4 mg/kg
Indeno(1,2,3-cd)pyrene	<0.33	3.4 mg/kg
Phenanthrene	<0.33	5.6 mg/kg
Pyrene	<0.33	8.2 mg/kg
Antimony	<0.06 mg/L TCLP	1.15 mg/L TCLP
Arsenic	<2 mg/kg	26.1 mg/kg
Barium	0.41 mg/L TCLP	21.0 mg/L TCLP
Beryllium	<0.005 mg/L TCLP	1.22 mg/L TCLP
Cadmium	<0.005 mg/L TCLP	0.11 mg/L TCLP
Chromium (total)	0.020 mg/L TCLP	0.60 mg/L TCLP
Lead	0.004 mg/L TCLP	0.75 mg/L TCLP
Mercury	<0.0005mg/L TCLP	0.025 mg/L TCLP

Table 4–2. Comparison of Concentrations in Ormet Residual Glass Frit to K088 Treatment Standards

Constituent of Concern	Maximum Ormet Concentration	Proposed or Existing Numerical Standard
Nickel	0.23 mg/L TCLP	11.0 mg/L TCLP
Selenium	0.006 mg/L TCLP	5.7 mg/L TCLP
Silver	<0.010 mg/L TCLP	0.14 mg/L TCLP

All treatment standards are existing standards in 40 CFR Part 268 with units of mg/kg unless otherwise indicated. Full Ormet data are presented in Appendix D.

4.3 Numerical Treatment Standard Development for Arsenic

On September 24, 1998 (63 FR 51254), EPA finalized an interim treatment standard for arsenic in K088. In nonwastewater forms of K088, the numerical interim treatment standard was established as 26.1 mg/kg and was based on data from the Reynolds process. EPA presented the available treatment data for arsenic supporting this interim rule in the August 1998 Notice of Data Availability (NODA) (August 4, 1998, 63 FR 41536).²³

During this current development of revised treatment standards for cyanide and fluoride, EPA also obtained arsenic data from the vitrified product, untreated waste, and baghouse dust of Ormet’s full-scale process. The same samples analyzed for cyanide and fluoride were analyzed for arsenic. EPA analyzed these samples using two different methods for total analyses and four different methods for leachate analyses.

Two different digestion methods were used for determining total arsenic. Following SW–846 Method 3051, total acid soluble arsenic was determined using a microwave assisted digestion technique with nitric acid. Alternatively, SW–846 Method 3052 was used to determine total arsenic by using hydrofluoric acid in order to completely digest the highly siliceous sample material. As shown in Table 4–3, the hydrofluoric acid digestion procedure yields higher values.

²³ Prior to that rule, the numerical treatment standard for arsenic in nonwastewater forms of K088 was 5.0 mg/L, and this data for K088 and other arsenic containing wastes were presented in EPA’s “Proposed Best Demonstrated Available Technology (BDAT) Background Document for Spent Potliners from Primary Aluminum Production — K088” (January 1995).

Leachable arsenic was determined using the following procedures: TCLP; TCLP modified to include ethylene diamine tetraacetic acid (EDTA) as the leaching medium; California Waste Extraction Test (CA WET); and CA WET modified by adjusting the liquid to solid ratio and leaching duration according to the TCLP protocol. As shown in Table 4–3, the CA WET procedure yields the highest values (i.e., it represents the most aggressive leaching fluid for these two materials).

In all analyses, the concentration of untreated arsenic is close to the detection limit, and specifically measures between 3.1 and 4.0 mg/kg in the totals analysis. Accordingly, Ormet’s untreated waste can not be considered “most difficult to treat”, and the near-detection-limit concentrations made it difficult to calculate the percentage of arsenic originally present in the feed that is present in the glass residue. However, using average values of total arsenic determined from HF digestion, Ormet’s process removes at least 42% of the arsenic (3.48 mg/kg in feed versus <2 mg/kg in residue).

Performance data from the Ormet process also indicated that arsenic is not immobilized in the treated potliner. As shown in Appendix D, elevated concentrations of arsenic were found to be present in baghouse dust, indicating that the arsenic vaporizes and is partitioned to the baghouse, which is then recycled back into the aluminum reduction pots or sold as product. Considering this, some amount of arsenic may not be collected in the baghouse dust, and most likely would be released in the stack emissions. Currently, the Agency does not have data that would indicate for certain what levels of either of these two potential events may occur and cannot make judgement about the effects of establishing an arsenic standard based on Ormet’s process or the potential risks associated with arsenic being released to air or land. Therefore, EPA has decided not to alter the existing arsenic treatment standard at this time and has planned to collect additional waste characterization data for arsenic to more fully address the concerns noted in the August 1998 NODA.

Table 4–3 shows that the concentration of arsenic in Ormet’s treated waste varies depending on the leaching test performed, with the TCLP giving the lowest concentration and the CA WET giving the highest concentration. In the case of the untreated K088, the final pH from

the CA WET is the highest of all of the tests (above 10 and closest to the pH of the material), while the other three tests result in a final pH of the leaching solution between 7.6 and 9.3. In the case of the treated glass, all of the tests result in a final pH in the narrow range of 5.0 to 5.4. This finding that TCLP results in the lowest measured mobility is consistent with the findings of the January 24, 1997 rule (62 FR 1992, emergency extension of the K088 capacity variance), where EPA found that leachable arsenic concentrations as determined by the TCLP were less than the concentrations found in landfill leachate. EPA may conduct additional testing of treated K088 wastes to more fully characterize the leaching of arsenic over a range of conditions such as pH or liquid to solid ratio.

Table 4–3. K088 Treatment Data From Ormet for Arsenic

Sample	Untreated Concentration						Treated Concentration					
	Total (mg/kg)	Total Acid- Soluble (mg/kg)	WET (mg/L)	Modified WET (mg/L)	TCLP (mg/L)	EDTA TCLP (mg/L)	Total (mg/kg)	Total Acid- Soluble (mg/kg)	WET (mg/L)	Modified WET (mg/L)	TCLP (mg/L)	EDTA TCLP (mg/L)
Arsenic Data												
1	4.0	<2	0.12	0.086	0.048	0.079	<2	<2	0.031	<0.025	<0.010	0.020
2	3.1	<2	0.12	0.089	0.044	0.077	<2	<2	0.033	<0.025	<0.010	0.023
3	3.3	<2	0.11	0.10	0.044	0.079	<2	<2	0.052	0.033	<0.010	0.020
4	3.5	<2	0.12	0.089	0.048	0.076	<2	<2	0.034	0.027	<0.010	0.023
pH Data: Final pH of leaching fluid (unitless)												
1	12.68		10.21	7.56	9.33	8.32	8.00		5.35	5.31	4.97	5.31
2	12.66		10.13	7.61	8.98	8.32	8.75		5.33	5.15	4.96	5.26
3	12.75		10.14	7.81	9.05	8.12	8.19		5.31	5.22	4.97	5.21
4	12.83		10.09	7.15	9.21	8.11	8.26		5.31	5.18	4.96	5.26

Source: Analysis of 4 samples of waste, analyzed prior to and following treatment at Ormet's full-scale process in Hannibal Ohio, plus 4 samples of baghouse dust. All data are presented in Appendix D.

5.0 CONCLUSIONS

This document presents EPA's rationale and technical support for developing revised Land Disposal Restriction (LDR) treatment standards for fluoride and cyanide found in nonwastewater forms of K088, spent potliners from primary aluminum reduction. EPA is proposing these revised LDR treatment standards, based on concentrations of treated glass residue samples of K088 waste, in accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) of 1976 enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984.

The concentration-based, numerical treatment standards development for cyanide and fluoride are based on 1999 Ormet data for its combustion melting system process. On June 15, 1999 EPA collected treatment performance data for the full-scale process at the Ormet Aluminum Company facility in Hannibal, Ohio. These samples consisted of the vitrified glass residue and the untreated spent potliner waste, and were analyzed to determine concentrations of total cyanide, amenable cyanide, total fluoride, leachable fluoride, and other parameters such as PAHs and other metal constituents. EPA determined that the manner in which the samples were collected and the resulting data met EPA's quality assurance requirements. Specifically, grab samples of both untreated K088 and treated glass residue were collected. The process was full scale and operating under typical conditions. Laboratory quality assurance results such as matrix spike analyses were found to be within the range acceptable for EPA's LDR program. Further, EPA determined that the process destroys over 99 percent of the cyanide and removes over 99 percent of the fluoride from the glass residue.

The resulting analytical data are presented in Appendix D. Sample results for amenable and total cyanide showed no outliers within the data sets and a variability factor each of 2.80. Sample results of leachable and total fluoride showed no outliers within the data sets and a variability factor of 1.37 and 1.25, respectively. Analysis of the data sets for amenable and total cyanide also resulted in a 1.00 and 0.92 accuracy correction factor, respectively. The leachable fluoride data set had an accuracy correction factor of 0.91, and the total fluoride data set had an accuracy correction factor of 1.23. The average concentration of amenable and total cyanide was

0.50 mg/kg, and the average concentration of leachable and total fluoride was 2.15 mg/L and 38.50 mg/kg, respectively. These data result in calculated treatment standards of 1.3 mg/kg for total cyanide, 1.4 mg/kg for amenable cyanide, 59 mg/kg for total fluoride, and 2.7 mg/L for leachable fluoride (as measured using distilled water as the leaching fluid in the TCLP). However, to resolve any compliance issues, the same treatment standard concentration is proposed for both amenable and total cyanide. Details of these calculations are presented in Appendix E. The calculated treatment standards are presented in Table 5-1.

EPA elected to use a leaching test for fluoride where distilled water was substituted as the leaching fluid in the TCLP. This method was chosen because it correlates better with actual field leachate conditions (i.e., as listed in Appendix D, the final pH of the treated glass residue ranged from 8.0 to 9.3). In the TCLP for this material, the final pH is about 5. Both untreated K088 and the treated glass residue have a pH above 8. The TCLP is an existing method used in the LDR program; the fluoride analysis is performed with a substitute of the leaching fluid.

EPA is planning to collect additional waste characterization data for arsenic to more fully address the concerns noted in the August 1998 NODA. The Agency is deferring further action on revised arsenic standards at this time pending completion of this additional research.

**Table 5–1. Summary of Treatment Standards Calculated from EPA
Data of Vitrified Product**

Constituent	Calculated Treatment Standard ^a
Total Cyanide ^d	1.4 mg/kg
Amenable Cyanide ^{c, d}	1.4 mg/kg
Total Fluoride	59 mg/kg
DI Water leachable fluoride ^b	2.7 mg/L

^a Treatment standard is calculated by multiplying the average concentration times the variability factor times the accuracy correction factor. The accuracy correction factor is the inverse of the lowest matrix spike recovery (not shown on this table).

^b The proposed fluoride treatment standard presented is based on a total fluoride analysis of a leaching procedure using distilled water as the leaching fluid in the TCLP. Fluoride analysis may be performed according to SW–846 Method 9056. No preparation of the sample extract should be necessary.

^c Generally, concentrations for amenable cyanide are less than or equal to those for total cyanide. In this case, according to actual laboratory results, the concentrations of amenable and total cyanide were both 0.50 mg/kg. The accuracy correction factor, which is multiplied with the actual concentration in the calculation of the treatment standard, was 1.00 for amenable cyanide and 0.92 for total cyanide; therefore, the calculated treatment standard concentration of the amenable cyanide was 1.4 mg/kg and total cyanide was 1.3 mg/kg. However, to resolve any compliance issues, we have proposed the same treatment standard concentration for both amenable and total cyanide. Refer to Appendix E to review detailed calculations of the standards.

^d The proposed cyanide treatment standards presented are based on total and amenable analyses. These analyses may be performed according to SW–846 Method 9010 or 9012. The methods must be followed, as written, for liquid samples. For solid samples, an additional note is presented in 40 CFR 268.40, footnote 7 of the Treatment Standard Table.

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Appendix A

Summary of Regulatory History Affecting K088

On December 18, 1978 (43 FR 58946), EPA proposed its initial regulations for hazardous waste management under Subtitle C of RCRA. These proposed regulations, among other things, identified a universe of “special wastes” that are generated in large volumes, were thought to pose less of a hazard than other hazardous wastes, and were thought not to be amenable to all of the control techniques proposed for other types of RCRA hazardous wastes. EPA identified waste materials from the “extraction, beneficiation, and processing of ores and minerals,” i.e., mining waste, as one such “special waste” under the proposed regulations.

On May 19, 1980, EPA promulgated the final hazardous waste management regulations. In promulgating these regulations, the Agency did not finalize the “special waste” category. The Agency listed as hazardous (as an interim final rule) eight wastes that are generated from primary metal smelters (45 FR 33112, May 19, 1980, and 45 FR 47832, July, 16, 1980), including spent potliners from primary aluminum reduction.

In October of 1980, RCRA was amended by adding Section 3001(b)(3)(A)(ii) to exclude “solid waste from the extraction, beneficiation, and processing of ores and minerals” from regulation as hazardous waste under Subtitle C of RCRA, pending completion of a study and a report to Congress. EPA modified its hazardous waste regulations in November 1980 to reflect this “mining waste exclusion,” and issued preliminary and quite broad interpretation of the scope of its coverage. In particular, EPA interpreted the exclusion to include “solid waste from the exploration, mining, milling, smelting and refining of ores and minerals” (45 FR 76618, November 19, 1980). To be consistent with its interpretation of the scope of the exclusion expressed in the November 19, 1980 notice, the Agency suspended the listings for five smelter wastes which it promulgated as final on November 12, 1980 (see 45 FR 76618). In addition, on January 16, 1981, the Agency suspended the other wastes that were promulgated as interim final on July 16, 1980. In suspending all of these listings, the Agency made it clear that although these wastes met the criteria for listing in 40 CFR 261.11, they appeared to come within the scope of the “mining waste exclusion.” The K088 listing was included in the suspended listings.

In 1984, EPA was sued for failing to submit the required Report to Congress and make the required regulatory determination by the statutory deadline (*Concerned Citizens of*

Adamstown v. EPA No. 84–3041, D.D.C., August 21, 1985). As a result of the lawsuit the Agency essentially split the wastes that might be eligible for exclusion into two groups: mining (mineral extraction and beneficiation) wastes and mineral processing wastes. On October 2, 1985, under the court order in *Adamstown*, EPA proposed to narrow the scope of the mining waste exclusion (50 FR 40292). Under this proposed reinterpretation, the suspension of the six smelting waste listings would be removed since they would no longer be considered “special wastes.” Therefore, the notice proposed to relist the six smelter wastes, including spent potliners.

Subsequently, on October 9, 1986, the Agency announced that it was withdrawing its proposed reinterpretation (51 FR 36233) because the terms “high volume” and “low hazard” had not been quantified in the proposal and, therefore, the Agency was unable to determine the status of additional wastes nominated by commenters as “special wastes” (51 FR 36234). While it did not view the “high volume, low hazard” standard as inherently unsound, EPA pointed to various definitional problems it faced in determining how to group and classify these wastes. The Agency concluded that its proposal had to be withdrawn because it failed to set “practically applicable criteria for distinguishing processing from non-processing wastes” and because there was insufficient time to repropose a rule in light of the *Adamstown* deadline. The withdrawal of the proposed reinterpretation effectively continued the suspension of the six smelter waste listings.

Subsequently, two suits were filed against EPA challenging the Agency’s decision to withdraw its proposed reinterpretation of the mining waste exclusion. The cases, *Environmental Defense Fund (EDF) v. EPA*, No. 86–1584 (D.C. Cir.) and *Hazardous Waste Treatment Council v. EPA*, No. 86–1691 (D.C. Cir.) were decided on July 29, 1988.

The U.S. Court of Appeals for the D.C. Circuit ruled in *EDF v. EPA* that EPA’s decision to withdraw the proposed reinterpretation and failure to relist the six smelting and refining wastes was arbitrary and capricious. The Court found that EPA’s inclusion of all smelting and refining wastes in the “mining waste exclusion” for ore processing wastes was “impermissibly overbroad” and contrary to Congressional intent. While the court conceded that the statutory term “processing” is ambiguous, the Court nonetheless found EPA’s interpretation to be unreasonable in light of “clear” legislative history that suggested that Congress had intended the Beville

Amendment to be limited to those ore processing wastes which meet EPA's 1978 "special waste" concept, i.e., those solid wastes that are high volume and low hazard.

In its order for relief, the Court directed EPA to relist the six smelter wastes by August 31, 1988. The Court noted that, regardless of the status of any additional processing wastes, the six smelter wastes clearly would not fit any definition of "high volume, low hazard." In summary, the Court found that the six wastes cannot, as a matter of law, be excluded from regulation under the Bevill amendment and must be regulated under Subtitle C if they meet the listing or identification criteria for hazardous wastes under 40 CFR 261.10 and 261.11. On September 13, 1988, the Agency published the final rule promulgating the hazardous listing for K088 waste generated from the primary reduction of aluminum (53 FR 35412).

In 1990, in *American Mining Congress v. EPA* No. 88-1835 (D.C. Cir.), six petitioners sued the Agency over the final listing decisions on the six smelting wastes. On July 10, 1990 the courts remanded five of the six listings; however, the court upheld the final listing for spent potliners from primary aluminum reduction.

In April 1996, EPA proposed the land disposal of both nonwastewater and wastewater forms of K088 in the Phase III Land Disposal Restriction rule. (61 FR 15566, April 8, 1996). The Phase III LDR prohibited the land disposal of spent potliner unless the waste satisfied the section 3004(m) treatment standard established in the same rulemaking. The Phase III rule also established concentration-based treatment standards for various constituents in both wastewater and nonwastewater forms of K088. These 25 constituents, included arsenic, cyanide, fluoride, toxic metals, and a group of organic compounds called polycyclic aromatic hydrocarbons.

With one exception, the treatment standard limits established for K088 were equivalent to the universal treatment standards in 40 CFR 268.48. The fluoride standard, however, was based generally on data submitted in a delisting petition from the Reynolds Metal Company. During a nine-month national capacity variance pursuant to Section 3004(h)(20), where the Agency allowed facilities generating K088 adequate time to work out logistics (61 FR 15589), unexpected performance problems in the Reynolds treatment process resulted in the generation of leachate

exhibiting characteristics of hazardous waste.²⁴ The company was also disposing of the treatment residues in non-subtitle C units. EPA therefore felt that further time was needed to evaluate whether adequate protective treatment capacity was available and, as part of this determination, whether Reynolds' practices in fact satisfied the mandate of Section 3004(m) that threats posed by land disposal of the hazardous waste be minimized through treatment. Until these questions were answered, and a finding of sufficient protective treatment capacity was made, there was insufficient treatment capacity for the waste because Reynolds, at the time, was the only existing commercial treatment facility for spent potliners. Consequently, on January 14, 1997 (62 FR 1992), the Agency extended the national capacity variance and postponed implementing the land disposal prohibition for an additional six months to be able to study the efficacy of the Reynolds treatment process and the resulting leachate.

In July 1997 (62 FR 37696), EPA announced that, "Reynolds' treatment (albeit imperfect) does reduce the overall toxicity associated with the waste," that disposal of treatment residues would occur only in units meeting Subtitle C standards, and consequently, treatment was an improvement over the disposal of untreated spent potliner and provided adequate protective treatment capacity. On October 8, 1997, the national capacity extension ended, and the prohibition on land disposal of untreated spent potliner took effect.

Subsequent to the publication of the Phase III rule, the January 1997 extension, and the July 1997 rule, petitions for judicial review were filed with the U.S. Court of Appeals for the District of Columbia. The petitioners, namely Columbia Falls Aluminum Company and other aluminum producers from the Pacific Northwest, argued (among other things) that use of the Toxicity Characteristic Leaching Procedure (TCLP) did not accurately predict the leaching of waste constituents, particularly arsenic and fluoride, to the environment and that it was, therefore, arbitrary to measure compliance with the treatment standard using this test. The U.S. Court of Appeals for the District of Columbia decided on April 3, 1998 that EPA's use of the TCLP as a

²⁴It was discovered that the Reynolds treatment process produced residues having actual leachate that contained higher concentrations of arsenic and fluoride than the concentrations predicted by the Toxicity Characteristic Leaching Procedure (TCLP). TCLP is an analytical test, SW-846 Method 1311, used for metals leachability testing. The procedure utilizes a sodium acetate solution, with a pH of 4.93, for extracting samples with a low alkalinity, and a dilute acetic acid solution is used for extracting samples with a high alkalinity.

basis for measuring concentrations for treatment standard calculations of K088 waste was arbitrary and capricious for those constituents for which the TCLP demonstratively and significantly underpredicted the amount of the constituent that would leach (138 F.3d 914). With this language only applied to arsenic and fluoride nonwastewaters, only 2 of 54 treatment standards were implicated; however, the Court vacated all of the treatment standards established for K088 in the Phase III rule and the prohibition on land disposal.

In response to the April 3, 1998 Court decision, EPA filed a motion with the Court on May 18, 1998 to delay issuance of its mandate for four months while the Agency promulgated a replacement prohibition and accompanying treatment standards. The Court granted this motion, indicating that its mandate would not issue before September 24, 1998.

Shortly thereafter, on September 24, 1998, the Agency published a final rule prohibiting the land disposal of K088 and promulgated interim replacement standards for K088, pending the completion of a review of all information on treatment processes that could serve as a basis for permanent, revised standards. (63 FR 51254, September 24, 1998.) The Agency reinstated the previously vacated standards for the 52 wastewater and nonwastewater treatment standards for which compliance was not measured through the use of the TCLP. For arsenic in nonwastewater forms of K088, the Agency promulgated a concentration-based numerical standard of 26.1 mg/kg, based on total arsenic concentrations. The concentration-based, numerical standard was determined from data sets submitted to the Agency identified in a Notice of Data Availability (NODA).²⁵ (63 FR 41536, August 4, 1998). For fluoride, the Agency elected not to develop an interim standard in nonwastewater K088, but to defer action until additional research and analysis could be completed. Refer to Appendix A for more information regarding the regulatory history affecting K088 treatment standard development, and Appendices B and C for additional information regarding the August 4, 1998 NODA and the September 24, 1998 final rule, respectively.

²⁵The August 4, 1998 NODA (63 FR 41536) issued by the Agency identified four data sets as possible data sets from which a total arsenic standard could be developed. Two of the data sets represented full-scale data from the treatment of K088 at the Reynolds Metal Company treatment facility. The other two data sets represented pilot-scale data from a combustion melting system process at the Ormet Corporation treatment facility.

Appendix B

August 4, 1998 Notice of Data Availability (63 FR 41536)

[Federal Register: August 4, 1998 (Volume 63, Number 149)]

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 268

[FRL-6133-9]

RIN 2050 AD38

**Land Disposal Restrictions--Treatment Standards for Spent
Potliners From Primary Aluminum Reduction (K088); Notice of Data
Availability**

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of data availability.

SUMMARY: EPA has received a number of data sets from which Land Disposal Restrictions (LDR) may be derived for EPA Hazardous Waste: K088—Spent potliners from primary aluminum reduction. In today's document, the Agency is presenting these data sets for comment in the context of developing a treatment standard for total arsenic (mg/kg) in K088 waste.

The public has 10 days from publication of this document to comment on these data sets and their utility in the development of K088 treatment standards. This document does not reopen for comment any other LDR Phase III or Phase IV issue.

DATES: Comments on this document must be submitted by August 14, 1998.

ADDRESSES: To submit comments, the public must send an original and two copies to Docket Number F-98-K88A-FFFFF, located at the RCRA Docket. The mailing address is: RCRA Information Center, U.S. Environmental Protection Agency (5305W), 401 M. Street, SW, Washington, D.C. 20460. RCRA Information Center is located at 1235 Jefferson Davis Highway, First Floor, Arlington, Virginia. The RCRA Information Center is open for public inspection and copying of supporting information for RCRA rules from 9 a.m. to 4 p.m. Monday through Friday, except for Federal holidays. The public must make an appointment to review docket materials by calling (703) 603-9230. A maximum of 100 pages may be copied from any regulatory document at no cost. Additional copies cost \$0.15 per page.

FOR FURTHER INFORMATION CONTACT: For general information or to order paper copies of this Federal Register document, call the RCRA Hotline. Callers within the Washington, Metropolitan Area must dial 703-412-9810 or TDD 703-412-3323 (hearing impaired). Long-distance callers may call 1-800-424-9346 or TDD 1-800-553-7672. The RCRA Hotline is open Monday-Friday, 9 a.m. to 6 p.m., Eastern Standard Time. For other information on this document, contact Elaine Eby (703) 308-8449 or Katrin Kral at (703) 308-6120, Office of Solid Waste, Mail Code 5302W, 401 M Street, SW, Washington, DC 20460.

SUPPLEMENTARY INFORMATION:

A. Paperless Office Effort

EPA is asking prospective commenters to voluntarily submit one additional copy of their comments on labeled personal computer diskettes in ASCII (TEXT) format or a word processing format that can be converted to ASCII (TEXT). It is essential to specify on the disk label the word processing software and version/edition as well as the commenter's name. This will allow EPA to convert the comments into one of the word processing formats utilized by the Agency. Please use mailing envelopes designed to physically protect the submitted diskettes. EPA emphasizes that submission of comments on diskettes is not mandatory, nor will it result in any advantage or disadvantage to any commenter. This expedited procedure is in conjunction with the Agency "Paperless Office" campaign. For further information on the submission of diskettes,

contact Elaine Eby of the Waste Treatment Branch at (703) 308-8449.

Availability of Rule on the Internet: Please follow these instructions to access the rule:

From the World Wide Web (WWW), type <http://www.epa.gov/fedrgstr>. For the text of the document, choose: Year/Month/Day.

B. Notice of Data Availability

I. Background

K088 (spent potliner from primary aluminum production)(40 CFR 261.32) is generated by the aluminum manufacturing industry. Aluminum production occurs in four distinct steps: (1) mining of bauxite ores; (2) refining of bauxite to produce alumina; (3) reduction of alumina to aluminum metal; and (4) casting of the molten aluminum. Bauxite is refined by dissolving alumina (aluminum oxide) in a molten cryolite bath. Next, alumina is reduced to aluminum metal. This reduction process requires high purity aluminum oxide, carbon, electrical power, and an electrolytic cell. An electric current reduces the alumina to aluminum metal in electrolytic cells, called pots. These pots consist of a steel shell lined with brick with an inner lining of carbon. During the pot's service the liner is degraded and broken down. Upon failure of a liner in a pot, the cell is emptied, cooled, and the lining is removed.

In 1980, EPA listed spent potliners as a RCRA hazardous waste and assigned the hazardous waste code K088. See 45 FR 47832 (1980).

The Phase III Land Disposal Restrictions Rule (61 FR 15566, April 8, 1996) prohibited the land disposal of untreated spent potliner unless the waste satisfied the section 3004(m) treatment standard established in the same rulemaking. Phase III established treatment standards, expressed as numerical concentration limits, for various constituents in the waste. These constituents included arsenic, cyanide, fluoride, toxic metals, and a group of organic compounds called polycyclic aromatic hydrocarbons (PAHs).

With the exception of fluoride, the treatment standard limits established for K088 were equivalent to the universal treatment standards, developed “by evaluating all existing Agency data from various technologies.” See 61 FR 15585; see also 40 CFR 268.48 (“Universal Treatment Standards” Table). The fluoride standard, however, was based on data submitted in a delisting petition from the Reynolds Metal Company. In the Phase III rule, the Agency granted a nine-month national capacity variance pursuant to section 3004 (h)(2) “to allow facilities generating K088 adequate time to work out logistics.” See 61 FR 15589.

Unexpected performance problems in the Reynolds treatment process resulted in the generation of leachate exhibiting characteristics of hazardous waste. Consequently, the Agency postponed implementing the land disposal prohibition for an additional six months on January 14, 1997 to be able to study the efficacy of the Reynolds treatment process and the leachate that was generated. See 62 FR 1992, January 14, 1997. (At the time, Reynolds was the only operational commercial treatment facility for K088.) In July 1997, EPA announced that, “Reynolds” treatment (albeit imperfect) does reduce the overall toxicity associated with the waste” and consequently was an improvement over the disposal of untreated spent potliner. See 62 FR 37696, July 14, 1997. On October 8, 1997, the extension ended and the prohibition on and disposal of untreated spent potliner took effect.

Petitions for judicial review of the Phase III rule and the January 1997 and July 1997 rules were filed by Columbia Falls Aluminum Company, et al. The petitioners argued that the use of the Toxicity Characteristic Leaching Procedure (TCLP) does not accurately predict the leaching of toxic constituents, particularly arsenic, to the environment. The United States Court of Appeals for the District of Columbia Circuit decided, on April 3, 1998, that EPA's use of the TCLP as a basis for setting treatment standards for K088 was arbitrary and capricious. The court consequently vacated the treatment standards for fluoride and the metals, including arsenic, which are expressed only in terms of the TCLP. The Court also vacated the prohibition on land disposal. (See *Columbia Falls Aluminum Company, et al., Petitioners v. Environmental Protection Agency*, No. 96-1234, D.C. Cir.) In its decision, the Court expressly invited EPA to file a motion to delay issuance of the mandate in this case for a reasonable time in order to develop a replacement standard (slip op. p. 21).

On May 18, 1998, EPA filed a motion with the D.C. Circuit Court to stay the decision while the Agency promulgated interim treatment standards under its Land Disposal Restrictions (LDR) program. The Court subsequently granted the Agency until September 24, 1998 to promulgate the aforementioned interim standards. This Notice of Data Availability is part of the Agency's effort to meet the court deadline of September 24.

II. Description of Data Sets for Total Arsenic Concentrations in Treated Potliner

Because the Reynolds treatment represents virtually all of the available capacity for potliner treatment and the actual leachate concentrations of arsenic as a result of the Reynolds treatment are not accurately predicted by the test conditions of the TCLP, the Agency is developing an alternative treatment standard for arsenic in K088 waste based on the total arsenic present. In this manner, the addition of arsenic-containing additives during treatment would be prohibited. The Agency has examined a number of data sets, with adequate analytical sensitivity, from which such a standard may be developed. In this section, the Agency presents for comment these data sets.

a. Reynolds Performance Data

In April 1998, the Agency received process performance data from Reynolds Metals Company. Total arsenic concentration data (mg/kg) were generated from grab samples collected from the kiln residue at Reynolds' Gum Springs, Arkansas plant from November 27, 1997 through December 26, 1997. These data consist of 30 measurements for total arsenic in treated residue. Total arsenic concentrations range from 8.77 to 27.6 mg/kg. Quality assurance/quality control (QA/QC) documentation is provided with the data. The source(s) of the potliner is not identified.

The Agency also received a one-page "Special Laboratory Report" (December 6, 1996) showing total arsenic concentrations (mg/kg) for K088 potliner in both the untreated and treated forms. The reported total arsenic concentrations (mg/kg) for these six data sets are as follows: untreated 5.17, treated 10.2; untreated 17.9, treated 11.0; untreated 7.89, treated 10.1; untreated 3.40, treated 8.90; untreated 4.82; treated 10.3; and untreated 8.14, treated 9.61. No quality

assurance quality control documentation is provided with this data. The source(s) of the potliner is not identified.

b. Ormet Delisting Petition

Data from the Ormet Primary Aluminum Corporation facility in Hannibal, Ohio was submitted to EPA in April 1994. The report, titled Petition for Exclusion for Vittrified Product From Spent Potliner, requested a delisting of their residues from their vitrification treatment process. The data in the report include arsenic concentrations found in five samples, taken from a pilot-scale combustion melting system (CMS) vitrification process to treat K088 wastes. Total arsenic concentrations (mg/kg) in the five treated waste samples are reported as: <2, <5, <5, <5, and 4.2. Quality assurance/quality control documentation for this data set consists of duplicate samples and matrix spike recoveries reported for three of the five samples.

c. Correspondence From Vortec Corporation

Pursuant to a request by the Agency for "totals" data from residuals produced from the vitrification of K088 in Vortec Corporation's vitrification process, data was received by the Agency in a letter from R. Sarah Compton, Kilpatrick Stockton LLP to Ms. Marilyn Goode, U.S. Environmental Protection Agency, dated February 26, 1997. In this letter, total arsenic concentrations are reported from two pilot-scale treatability studies conducted on K088 waste. The first data set concerned tests conducted on waste generated by Ravenswood Aluminum. This data consists of only one datum point for total arsenic, which was measured as "not detected" (less than 3 mg/kg total arsenic). The second data set shows the results of a pilot-scale treatability study of K088 wastes generated by Alumax Corporation. Total arsenic concentrations (mg/kg) for this data set consist of seven data points: 4, 5, <3, <3, <3, <3, and <3. No quality assurance/quality control (QA/QC) documentation is provided for either of the data sets.

III. Development of Total Arsenic Treatment Standard

As noted, the Agency is noticing for comment five data sets, one or more of which will

likely be used to develop a total arsenic treatment standard for K088 waste that will be promulgated by September 24, 1998. The Agency's Land Disposal Restrictions Program (LDR) has specific requirements for any data set evaluated for possible Best Demonstrated Available Technology (BDAT) analysis. A full range of information is necessary to determine whether a treatment and its corresponding performance data warrants further evaluation for possible development of the treatment standard. For example, waste characterization; treatment design and operating conditions; and quality assurance/quality control (QA/QC) documentation are all necessary components of a "BDAT quality" data set. See USEPA "Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures and Methodology," Office of Solid Waste, October 23, 1991.

The Agency is currently conducting a thorough evaluation of the aforementioned data sets with regard to the BDAT protocols. If, however, the Agency were to calculate a treatment standard from one of these data sets as they are presented today, a total arsenic treatment standard for K088 would range between 5 and 26 mg/kg total arsenic, depending on the data set.

IV. Documents Supporting This NODA

The documents being placed in the docket for this NODA include:

1. USEPA, Preliminary Calculation of Nonwastewater Treatment Standard for Total Arsenic Found in Spent Potliners From Primary Aluminum Reduction, July 1998.
2. Spent Potliner Analytical Data, Partial Petition for Exclusion, Ormet Corporations, Hannibal, Ohio. (To view entire petition, refer to (F-95-PH3P-S0108 and F-95-PH3P-S0108.a))
3. "Special Laboratory Report," December 6, 1996. Reynolds Metals Company.
4. Letter from R. Sarah Compton, Kilpatrick Stockton LLP to Ms. Marilyn Goode, U.S. EPA, February 26, 1997.
5. Reynolds Lab Reports, Reynolds Metals Company, November 27, 1997 through December 26, 1997.

List of Subjects in 40 CFR Part 268

Environmental protection, Hazardous waste, Reporting and recordkeeping requirements.

Dated: July 23, 1998.

Elizabeth A. Cotsworth,

Acting Director, Office of Solid Waste.

[FR Doc. 98-20607 Filed 8-3-98; 8:45 am]

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Appendix C

September 24, 1998 Rule (63 FR 51254)

Federal Register: September 24, 1998 (Volume 63, Number 185)

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 268 and 271

[FRL-6168-7]

RIN 2050-ZA01

**Land Disposal Restrictions; Treatment Standards for Spent
Potliners From Primary Aluminum Reduction (K088)**

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: EPA is promulgating treatment standards for spent potliners from primary aluminum reduction (EPA hazardous waste: K088) under its Land Disposal Restrictions (LDR) program. The purpose of the LDR program, authorized by the Resource Conservation and Recovery Act (RCRA), is to minimize threats to human health and the environment due to land disposal of hazardous wastes. As a result of today's rule, spent potliners will be prohibited from land disposal unless the wastes have been treated in compliance with the numerical standards contained in this rule. These treatment standards are necessary to minimize threats to human health and the environment from exposure to hazardous constituents which may potentially leach from landfills to groundwater.

EFFECTIVE DATE: September 21, 1998.

ADDRESSES: Supporting materials are available for viewing in the RCRA Information Center (RIC), located at Crystal Gateway I, First Floor, 1235 Jefferson Davis Highway, Arlington, VA. The RIC is open from 9 a.m. to 4 p.m., Monday through Friday, excluding federal holidays. The Docket Identification number is F-98-K88F-FFFFF. To review docket materials, it is recommended that the public make an appointment by calling (703) 603-9230. The public may copy a maximum of 100 pages from any regulatory docket at no charge. Additional copies cost \$0.15/page. The index and some supporting materials are available electronically. See the "Supplementary Information" section for information on accessing them.

FOR FURTHER INFORMATION CONTACT: For general information, contact the RCRA Hotline at (800) 424-9346 (toll-free) or TDD (800) 553-7672 (hearing impaired). In the Washington, DC, metropolitan area, call (703) 412-9810 or TDD (703) 412-3323. For specific information, contact Elaine Eby, John Austin, or Katrin Kral, Office of Solid Waste (5302W), U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460. Elaine Eby may be reached at 703-308-8449, eby.elaine@epamail.epa.gov; John Austin may be reached at 703-308-0436, austin.john@epamail.epa.gov; and Katrin Kral may be reached at 703-308-6120, kral.katrin@epamail.epa.gov. For information on the capacity analysis, contact C. Pan Lee (5302W) at 703-308-8478, lee.cpan@epamail.epa.gov. For questions on the regulatory impact analysis, contact Paul Borst (5307W) at 703-308-0481, borst.paul@epamail.epa.gov.

SUPPLEMENTARY INFORMATION:

Availability of Rule on Internet

Please follow these instructions to access the rule: From the World Wide Web (WWW), type <http://www.epa.gov/rules> and regulations.

Affected Entities

Entities potentially affected by this action are generators of spent aluminum potliner from primary aluminum reduction, or entities that treat, store, transport, or dispose of these wastes.

Category	Affected entities

Industry	Generators of the following listed wastes, or entities that treat, store, transport, or dispose of these wastes.
	K088--Spent potliners from primary aluminum reduction.

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be affected by this action. This table lists those entities of which EPA now is aware that potentially could be affected by this action. Other entities not listed in the table also could be affected. To determine whether your facility is regulated by this action, you should examine 40 CFR parts 260 and 261 carefully in concert with the amended rules found at the end of this Federal Register document. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the preceding FOR FURTHER INFORMATION CONTACT section.

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I. Background

A. Process Description

K088 (spent potliners from primary aluminum reduction) (40 CFR 261.32) is generated by the aluminum manufacturing industry. Aluminum production occurs in four distinct steps: (1) mining of bauxite ores; (2) refining of bauxite to produce alumina; (3) reduction of alumina to aluminum metal; and (4) casting of the molten aluminum. Bauxite is refined by dissolving alumina (aluminum oxide) in a molten cryolite bath. Next, alumina is reduced to aluminum metal. This reduction process requires high purity aluminum oxide, carbon, electrical power, and an electrolytic cell. An electric current reduces the alumina to aluminum metal in electrolytic cells, called pots. These pots consist of a steel shell lined with brick with an inner lining of carbon. During the pot's service the liner is degraded and broken down. Upon failure of a liner in a pot, the cell is emptied, cooled, and the lining is removed. In 1980, EPA originally listed spent potliners as a RCRA hazardous waste and assigned the hazardous waste code K088. See 45 FR 47832.

B. Regulation

The Phase III--Land Disposal Restrictions Rule (61 FR 15566, April 8, 1996) prohibited the land disposal of spent potliner unless the waste satisfied the section 3004(m) treatment standard established in the same rulemaking. The Phase III rule established treatment standards, expressed as numerical concentration limits, for various constituents in the waste (25 in all, with standards for both wastewaters and non-wastewaters). These constituents included arsenic, cyanide, fluoride, toxic metals, and a group of organic compounds called polycyclic aromatic hydrocarbons (PAHs).

With the exception of fluoride, the treatment standard limits established for K088 were equivalent to the universal treatment standards. See 61 FR 15585; see also 40 CFR 268.48

("Universal Treatment Standards" Table). The fluoride standard, however, was based generally on data submitted in a delisting petition from the Reynolds Metals Company. In the Phase III rule, the Agency granted a nine-month national capacity variance pursuant to section 3004(h)(2) "to allow facilities generating K088 adequate time to work out logistics." See 61 FR 15589.

Unexpected performance problems in the Reynolds treatment process resulted in the generation of leachate exhibiting characteristics of hazardous waste. In addition, the company was disposing of the treatment residues in non-subtitle C units. EPA therefore felt that further time was needed to evaluate whether adequate protective treatment capacity was available (within the meaning of RCRA section 3004(h)(2)), and, as part of this determination, whether Reynolds' practices in fact satisfied the mandate of section 3004(m) that threats posed by land disposal of the hazardous waste be minimized through treatment. Until these questions were answered, and a finding of sufficient protective treatment capacity made, there was insufficient treatment capacity for the waste because Reynolds, at the time, was the only existing commercial treatment facility for spent potliners. Consequently, on January 14, 1997, the Agency extended the national capacity variance, and postponed implementing the land disposal prohibition for an additional six months to be able to study the efficacy of the Reynolds treatment process and the resulting leachate. See generally 62 FR 1992.

In July 1997, EPA announced that, "Reynolds" treatment (albeit imperfect) does reduce the overall toxicity associated with the waste," and that disposal of treatment residues would occur only in units meeting subtitle C standards and consequently was an improvement over the disposal of untreated spent potliner and provided adequate protective treatment capacity. See 62 FR 37696 (July 14, 1997). On October 8, 1997, the national capacity extension ended and the prohibition on land disposal of untreated spent potliner took effect.

C. Litigation

Petitions for judicial review of the Phase III rule, and the January 1997, and July 1997 rules were filed by Columbia Falls Aluminum Company, and other aluminum producers from the

Pacific Northwest. The petitioners argued (among other things) that the use of the Toxicity Characteristic Leaching Procedure (TCLP) did not accurately predict the leaching of waste constituents, particularly arsenic and fluoride, to the environment and that it was therefore arbitrary to measure compliance with the treatment standard using this test. The United States Court of Appeals for the District of Columbia Circuit decided on April 3, 1998, that EPA's use of the TCLP as a basis for setting treatment standards for K088 was arbitrary and capricious for those constituents for which the TCLP demonstratively and significantly underpredicted the amount of the constituent which would leach. 139 F.3d 914; see also 63 FR 28571 (May 26, 1998) (EPA's interpretation Court's opinion). Notwithstanding that this finding affected only two of the hazardous constituents for which EPA established treatment standards, namely arsenic and fluoride nonwastewaters (so that only 2 of 54 treatment standards were implicated), and the Court's express statement that "[o]ur decision today does not affect the viability of the concentration limits established for other constituents," 139 F. 3d at 923, the Court vacated all of the treatment standards and the prohibition on land disposal. *Id.* at 923-24. In its decision, the Court expressly invited EPA to file a motion to delay issuance of the mandate in this case for a reasonable time in order to develop a replacement standard. *Id.* On May 18, 1998, EPA filed a motion with the Court to stay its mandate for four months while the Agency promulgated a replacement prohibition and accompanying treatment standards. The motion explained at length the type of standard EPA expected to adopt and in fact is adopting in this document. The Court granted this motion over the objections of Petitioners, indicating that its mandate would not issue before September 24, 1998. Today's action promulgates interim replacement standards for K088 which will be in place until EPA has fully reviewed all information on all treatment processes which may serve as a basis for a more permanent revised standard.

II. Prohibition on Land Disposal of Untreated K088

As just noted, this rule promulgates a land disposal prohibition for K088 waste and establishes interim treatment standards. EPA is issuing this replacement prohibition to assure that the fundamental premise of the statute--a prohibition on land disposal of hazardous waste not

satisfying treatment standards which result in substantial destruction or immobilization of the waste--is not weakened. See *Chemical Waste Management v. EPA*, 976 F. 2d 2, 22, 25 (D.C. Cir. 1992) (prohibition and treatment standards are the heart of the RCRA hazardous waste management scheme). Congress enacted the prohibition regime due to "the long-term uncertainties associated with land disposal, the goal of managing hazardous waste in an appropriate manner in the first instance, and the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous wastes and their hazardous constituents." RCRA section 3004(d)(1)(A)-(C). The legislative history states that the statute "makes Congressional intent clear that land disposal without prior treatment of these wastes with significant concentrations of highly persistent, highly toxic, highly mobile and highly bioaccumulative constituents is not protective of human health and the environment." 130 Cong. Rec. S9178 (daily ed. July 25, 1984) (floor statement of Sen. Chafee introducing amendment which became section 3004 (m)).

Spent potliners are exactly this type of waste: highly toxic, containing persistent and bioaccumulative hazardous constituents, and associated with numerous damage incidents arising from improper land disposal. Among the highly toxic, mobile, and bioaccumulative hazardous constituents found in the waste are cyanide, polyaromatic hydrocarbons, and toxic metals. The Agency believes that the land disposal of untreated spent potliners (K088) is a highly undesirable management scenario, that would result in large volumes of hazardous constituents being land disposed, constituents which would otherwise be destroyed or immobilized by treatment.

These untreated hazardous constituents can pose significant threats to human health and the environment. For example, treatment of K088 waste to the interim standards promulgated today will ensure that cyanide--the most dangerous constituent in spent potliners based on its concentration, toxicity, and the extent of contamination caused by past land disposal of untreated spent potliners--will be largely destroyed. See 62 FR 37696 (July 14, 1997) (spent potliners listed as hazardous due to the presence of cyanide). See also Docket items PH3F-S0015 and S0016 (summary of damage incidents involving improper disposal of spent potliners, showing extensive cyanide contamination of groundwater and soil); see also Section VIII A. below, revising EPA's

previous erroneous analysis that cyanide leaching from spent potliners would not pose a threat to groundwater. EPA, in fact, estimates that compliance with the land disposal prohibition and interim treatment standard for cyanide will result in the annual reduction of approximately 300 tons of cyanide being land disposed. Docket item P33F-S0012. Cyanide also will leach from untreated spent potliners in concentrations hundreds of times higher than the highest level observed in leachate from potliners treated to meet existing standards. Docket Item PH3F-S0049A at data set J and 62 FR 37695 (July 14, 1997). EPA thus views the prohibition and treatment standards as reducing by orders of magnitude the amount of cyanide actually leached from these wastes.

In addition, treatment to meet the treatment standards will destroy all the polyaromatic hydrocarbons in spent potliners. These are highly carcinogenic compounds which have caused environmental contamination at the spent potliner damage sites. Docket PH3F-S0015 and S0016. Finally, virtually all of the toxic metals--some of which likewise caused environmental contamination at the damage sites, id.--will be immobilized.

Petitioners nevertheless argue in public comments that EPA should not retain a land disposal prohibition at this time, but rather allow spent potliners to be disposed untreated until the Agency completes its evaluation of different treatment technologies and (potentially) amends treatment standards based upon the performance of these technologies. This result is antithetical to the statutory scheme. Congress has found that land disposal is inherently unsafe because landfills are not capable of assuring long-term containment of certain hazardous wastes, and that land disposal of hazardous waste should be minimized in favor of properly conducted treatment. RCRA sections 1002(b)(7) and 1003(a)(6). Congress therefore intended to end land disposal of hazardous waste without prior treatment: ``The intent here is to require utilization of available technology in lieu of continued land disposal without prior treatment." 130 Cong. Rec. S9178 (July 25, 1984) (statement of Sen. Chafee). Petitioners' argument to do no treatment at all because two treatment standards out of 54 are not optimized (and one of which is now being appropriately revised) would frustrate this explicit Congressional intent and EPA's overall

commitment to protection of human health and the environment. EPA is simply not willing to permit the continued land disposal of 300 tons of untreated cyanide annually in the face of a statutory scheme calling for untreated land disposal to cease and calling for destruction of cyanide before land disposal. 130 Cong. Rec. S 9179. This is particularly the case when destruction of cyanide (and destruction of PAHs and immobilization of hazardous constituent metals) and consequent minimization of threats will be assured through treatment. Finally, the Congressionally mandated date for prohibiting spent potliners from land disposal--March, 1989 (per RCRA section 3004(g)(4))--has long since passed. Consequently, EPA is acting today to assure that spent potliners remain prohibited from land disposal.

III. Interim Treatment Standards

A. Introduction

EPA has both a short-term and long-term objective for treatment standards for K088 waste. The Agency's long-term goal, expected to be completed within two years, is to promulgate another set of treatment standards for spent potliners (K088) based on the performance of a treatment technology which results in the immobilization of arsenic and fluoride, as well as the other toxic metals in the waste (these metals will be immobilized by meeting the treatment standards established in today's rule). The Agency is aware of numerous technologies that may be used to treat K088 waste, a number of which may be finally coming on line as commercially available.\1\ However, at the present time, there are insufficient data or information on these technologies to provide the basis for a rapidly implementable final treatment standard. More information is needed to characterize the performance of these technologies, as well as to assess their safety and (in some cases) the safety of hazardous waste-derived products which may be generated as part of these treatment processes. Cf. *Chemical Waste Management*, 976 F. 2d at 17 (treatment technologies whose air emissions are not adequately controlled are not treating in conformance with requirements of section 3004(m)). The Agency is in the process of gathering and identifying potential technologies that may be evaluated as the basis for a permanently revised

treatment standard. EPA is studying technologies such as vitrification, gasification, the ``Cashman Process," and the ``Alcoa-Selca" process. The Agency plans to propose a standard for K088 within the next twelve months. -----

\1\ The Agency notes that although there has been much said about potential marketing of potliner treatment technologies, see 60 FR 11724-11725 (March 2, 1995) (detailing technologies potentially able to treat spent potliners), these technologies were not offered commercially until EPA's promulgation of an actual land disposal prohibition. (The notable exception is the Reynolds Metals process, which the company brought to market a bit before spent potliners were prohibited from land disposal in 1996. Id. at 11723.) Without a prohibition further development of commercial treatment thus could easily end. This is another reason EPA believes it imperative to retain the prohibition on land disposal of K088 wastes.

B. Detailed Discussion of the New Treatment Standards

1. Cyanide, Polyaromatic Hydrocarbons, and Certain Metals

The D.C. Circuit found the existing treatment standards arbitrary and capricious because the TCLP was significantly overpredicting the extent to which certain hazardous constituents would be immobilized by treatment. The problem arose because certain constituents in the waste are more soluble in alkaline rather than weakly acidic conditions. Since the TCLP uses a weakly acidic extractant for these constituents, the TCLP was not modeling a reasonable worst case disposal situation at all, but instead was failing to predict what occurs when treated potliners are disposed in industrial landfills. See generally 139 F. 3d at 922.

However, only two of the 54 treatment standards suffer from this deficiency. The treatment standards for cyanide and PAHs do not use the TCLP at all, but rather are implemented

on a total constituent concentration basis. (As noted earlier, the Court expressly held that these standards are reasonable. (139 F. 3d at 923.)) Likewise, none of the standards for wastewaters use the TCLP. In addition, none of the standards for metals, except for arsenic and fluoride, suffer from any deficiency even though the TCLP is used to measure compliance. These other metals are not highly alkaline soluble, so that the TCLP will not underpredict environmental performance as occurred with arsenic and fluoride. In fact, leachate sampling data from the Reynolds facility shows reasonable correlation with levels predicted by the TCLP, and further indicates that the TCLP is not underpredicting leachate levels of these metals. Docket Item P33F-S0002.B.\2\

\2\ Commenters argued that the TCLP could not be used to measure compliance with these standards under the reasoning of Columbia Falls, and that there is no information showing that the acidic leaching media used in the TCLP would be a reasonable predictor for leaching of these metals under alkaline disposal conditions. Comment p. 11. As mentioned in the text, these assertions are not correct. The TCLP is not underpredictive of actual leaching for these wastes because the other metals are not more mobile under alkaline conditions. This is borne out by the actual leachate data (cited above) showing reasonable correlation between predicted and actual leachate levels and, most importantly, confirming that all of the other toxic metals are substantially immobilized as required by section 3004(m).

The Agency is thus today repromulgating those portions of the K088 treatment standard that do not suffer from the deficiencies noted in the Court's opinion. These are the standards for the following constituents in both wastewaters and nonwastewaters: acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and cyanide. The nonwastewater treatment standards for cyanide and the organic constituents, and all of the standards for wastewaters, are based on a total composition

concentration analysis. The nonwastewater treatment standards for the metal constituents are based on analysis using the TCLP. As noted above, these standards are essential in ensuring that the toxicity of K088 is "substantially diminished" and threats to human health and the environment are thereby minimized (RCRA section 3004(m)(2)) through the destruction of cyanides and organics and the immobilization of toxic metals prior to land disposal.

2. Total Arsenic Standard

The Agency is promulgating a revised treatment standard for arsenic in nonwastewater forms of K088, based on a total recoverable arsenic concentration from strong acid digestion, as defined by EPA SW-846 Method 3050, 3051, or the equivalent, hereafter referred to as "total arsenic." This change to the K088 treatment standard addresses the D.C. Circuit's holding that EPA arbitrarily relied on an inaccurately predictive model (the TCLP) in promulgating the K088 treatment standard. The Agency recognizes that for K088 nonwastewaters, arsenic treatment, (i.e., immobilization) may not be accurately predicted through the use of the TCLP because the TCLP uses a weakly acidic extractant, whereas actual disposal conditions are often highly alkaline (due to the potliner's alkalinity), and arsenic is more soluble under highly alkaline than weakly acidic conditions. See 62 FR 1993 (January 14, 1997). Specifically, the TCLP uses a weakly acidic leachate (pH 5.0) which, together with the alkaline treatment residual (K088), results in a leachate pH of approximately 7.6 and not the observed landfill pH of approximately 12.5, at which arsenic is highly mobile. However, because there is no other predictive leaching test available at this time, the Agency has developed an alternative treatment standard for arsenic in K088 nonwastewaters based on the total arsenic present in the treatment residue. As explained below, this total arsenic treatment standard for K088 will be consistent with the current improved performance of the Reynolds process, which has been reconfigured to reduce use of arsenic-containing additives during treatment. The standard also should ensure that the treatment process successfully incorporates the arsenic into the matrix of the treated residual and so minimizes environmental release. This is because arsenic is soluble under strongly acidic conditions, so that the total arsenic analytic method (strong acid digestion) measures all arsenic

not incorporated into an impervious silica matrix.

On August 4, 1998 (63 FR 41536), the Agency issued a Notice of Data Availability (NODA) identifying four data sets as possible data sets from which a total arsenic standard could be developed. Two of the data sets represented full-scale data from the treatment of K088 at the Reynolds Metals Company treatment facility ³, and two data sets represented pilot-scale data from vitrification ⁴ treatment studies. We discuss below the Agency's choice of data set for establishing a revised treatment standard.

\3\ The Reynolds treatment process entails the crushing and sizing of spent potliner materials (K088), the addition of roughly equal portions of limestone and "sand" as flux, and the feeding of the combined mixture to a rotary kiln for thermal destruction of cyanide and PAHs, while reducing the mobility of the fluoride and arsenic in the resulting slag. 62 FR 37694, July 14, 1997.

\4\ Vitrification is a treatment process which involves dissolving the waste at high temperatures into glass or a glass-like matrix. High temperature vitrification is applicable to nonwastewaters containing arsenic or other characteristic toxic metal constituents that are relatively nonvolatile at the temperatures at which the process is operated. Volatile arsenic compound are usually converted to nonvolatile arsenate salts such as calcium arsenate prior to the use of this process. See USEPA "Treatment Technology Background Document", Office of Solid Waste, January 1991. (Document is available in the docket for today's rule. F-98-K88F-FFFFF)

The first data set, generated in late 1997 by the Reynolds Metals Company, consists of 30 measurements for total arsenic in treated K088 waste. Total arsenic concentrations ranged from 8.77 to 27.6 mg/kg. Quality assurance/quality control (QA/QC) documentation was provided with the data. The second data set has also been generated by Reynolds and identified as a one-page

``Special Laboratory Report" (December 6, 1996) showing total arsenic concentrations (mg/kg) for K088 potliner in both the untreated and treated forms. This data set consists of six treated and untreated data pairs. No quality assurance/quality control documentation was provided with these data.

The third data set was submitted to the EPA in 1994 from the Ormet Primary Aluminum Corporation facility in Hannibal, Ohio (see 63 FR 41536, August 4, 1998). These data consisted of arsenic samples, analyzed on a total arsenic basis, taken from a pilot-scale vitrification unit treating K088 waste. This data set consists of five treated and untreated data pairs. Partial quality assurance/quality control documentation was provided with this data set.

The fourth data set, generated in 1997, consists of pilot-scale data from two vitrification studies on K088 waste from two different generators. The first study consisted of only one datum point on total arsenic measuring ``not detected" (less than 3 mg/kg total arsenic). Total arsenic concentrations (mg/kg) for this second study consisted of seven data points. No quality assurance/quality control nor any waste characterization documentation were provided.

When evaluating any performance data set with regard to its treatment effectiveness on a particular hazardous constituent, the Agency's Land Disposal Restrictions Program (LDR) has specific requirements for any data set evaluated for possible Best Demonstrated Available Technology (BDAT) analysis. A full range of information is necessary to determine whether a treatment and its corresponding performance data warrants further evaluation for possible development of the treatment standard. For example, waste characterization; treatment design and operating conditions; and QA/QC documentation are all necessary components of a ``BDAT quality" data set. See USEPA ``Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures and Methodology," Office of Solid Waste, October 23, 1991.

The Agency has completed a thorough evaluation of the four data sets with regard to

BDAT protocols. As discussed above, each data set has certain limitations. Faced with imperfect data, EPA has used the best data available to set this interim standard. EPA has determined that the data set consisting of 30 data points submitted by the Reynolds Metals Company is the most appropriate for development of a total arsenic standard for K088 nonwastewaters. This decision was made for a number of reasons. First, when developing any treatment standard, the Agency attempts to collect as much data as possible to reflect the diversity of the waste stream. With respect to the Reynolds 30-day data, the data satisfy this objective by having the most diverse range of total arsenic concentrations (8.77 to 27.6 mg/kg) in treated spent potliners. In fact, the data represented treatment of spent potliners from 15 of the 23 aluminum producers in the United States. ⁵ Conversely, the vitrification data sets (covering spent aluminum potliners from three different aluminum facilities) show no such diversity and are limited to five, one, and seven data points respectively. While the Agency does not have untreated data on total arsenic concentrations for the Reynolds 30-day data set, the data are consistent with the other data sets and previously reported maximum arsenic concentrations for untreated and treated spent potliner (56 FR 33004, July 18, 1991).

\5\ Comment K88A-00002.

Second, the Reynolds 30-day data are the most current of the four data sets and contain all the necessary quality assurance quality control documentation, unlike the three other data sets. Third, the Reynolds 30-day data set is based on full-scale data while the vitrification data set is based on pilot-scale treatability studies. EPA as part of its LDR program prefers to use full-scale data when developing treatment standards. See ``Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures and Methodology," Office of Solid Waste, October 23, 1991.

Furthermore, the data should be from an optimized and well run process. Reynolds has

endeavored to isolate and remove additional sources of arsenic in their process (by changing treatment reagents) and to lower the pH of the residue, which may further reduce arsenic leachability. Reynolds' original process appeared actually to increase the amount of leachable arsenic in the treated waste, possibly due to the destruction of organic components in the K088 combined with the arsenic levels in the sand that is used as a fluxing agent in the process. 62 FR 37694. Reynolds has recently changed the type of sand used as a fluxing agent (from so-called Brown Sand to Red Clay Sand), and the 30-day data was produced using Reynold's revised process utilizing Red Clay Sand as a treatment additive. Two separate landfill leachate analytical results from Reynolds, dated May 26, 1998 and June 25, 1998, indicate that leachate levels for arsenic in Cell 2 (the cell which is currently accepting treated K088 waste and using Red Clay Sand as a treatment additive) are significantly lower than arsenic levels from the leachate in Cell 1 (no longer receiving treated K088 waste and containing instead the waste generated using the Brown Sand fluxing agent): 15.7 mg/L and 21.6 mg/L (Cell 1) versus 3.82 mg/L and 1.23 mg/L (Cell 2), respectively.⁶ This suggests that Reynolds is minimizing the amount of arsenic imported to their treatment process, and further minimizing the amount which is released to the environment in accord with section 3004(m). Accordingly, the Agency has calculated and is promulgating an interim final treatment standard of 26.1 mg/kg total arsenic for nonwastewater forms of K088 based on the Reynolds 30-day data set. The total arsenic standard adopted today ``by using data reflecting this improved performance should ensure the observed reduction in mobile arsenic. EPA thus finds that this new standard does result in significant reduction in arsenic mobility and consequent minimization of threats posed by disposal of spent potliners. See RCRA section 3004(m)(1).

\6\ These leachate levels are in fact significantly lower than the initial treatment standard (5.0 mg/L measured by the TCLP) for arsenic.

3. Fluoride

The solubility of fluoride ions is largely governed by the metal ions present and pH. The conditions of the TCLP fail to predict the mobility of fluoride under actual disposal conditions, since fluoride is more soluble under highly alkaline conditions (like the conditions of a dedicated monofill, such as utilized by Reynolds), and not the neutral to weakly basic conditions that result during the TCLP test conducted on the highly alkaline K088 potliner. 62 FR 1993. Consequently, the Court held that the TCLP was not a proper predictive model for fluoride mobility from these wastes.

EPA has decided not to develop an interim standard for fluoride. It would take significant technical effort to develop a replacement treatment standard for this constituent and EPA would not be able to meet the D.C. Circuit's deadline of September 24, 1998. The current data are insufficient on which to base a treatment standard that would not be TCLP-based. Therefore, EPA would need to engage in a substantial testing and/or a data gathering effort using alternative test methods. EPA believes that this type of considerable technical resource effort is better directed, given current circumstances, to developing the long-term, more permanent treatment standard described earlier. Moreover, as a practical matter, treatment of K088 potliners to meet the other metal treatment standards will result in some immobilization of fluoride as well. ⁷ As a result, looking at the totality of additional environmental protection gained from these interim standards for the suite of hazardous constituents involved, we conclude that immediate promulgation of these interim standards (even without a specific fluoride standard) constitutes the best practical approach to minimizing threats to human health and the environment. The issue of fluoride treatment will of course be fully explored as part of the longer-term effort to establish more permanent treatment standards for K088 waste.

\7\ For example, the chief existing treatment process, operated by Reynolds Metals, does provide some treatment of fluoride, on the order of at least 28% reduction in fluoride mobility (based on comparison of fluoride leached from untreated potliners using neutral extractant column tests and levels of fluoride in actual leachate from the Reynolds' disposal unit). Docket Items

P33F-S0064 and S0049 Attachment A data set J. This level of treatment will necessarily occur, at least in the Reynolds process, because the process does not treat each constituent selectively.

IV. Capacity Determination

A. Introduction

This section summarizes the results of the capacity analysis for the wastes covered by today's rule. For a detailed discussion of capacity analysis-related data sources, methodology, and summary of analysis for K088 covered in this rule, see the background documents entitled ``Background Document for Capacity Analysis Update for Land Disposal Restrictions--Phase III: Spent Aluminum Potliners (July 1997)" (62 FR 37694 i.e., referred to as the ``Capacity Background Document").

In general, EPA's capacity analysis focuses on the amount of waste to be restricted from land disposal that is currently managed in land-based units and that will require alternative treatment as a result of the LDRs. The quantity of wastes that are not managed in land-based units (e.g., wastewater managed only in RCRA exempt tanks, with direct discharge to a Publicly Owned Treatment Works (POTW)) is not included in the quantities requiring alternative treatment as a result of the LDRs. Also, wastes that do not require alternative treatment (e.g., those that are currently treated using an appropriate treatment technology) are not included in these quantity estimates.

EPA's decisions on when to establish the effective date of the treatment standards (e.g., whether to grant a national capacity variance) are based on the availability of appropriate treatment or recovery technologies. Consequently, the methodology focuses on deriving estimates of the quantities of waste that will require either commercial treatment or the construction of new on-site treatment as a result of the LDRs. EPA attempts to subtract from the required capacity

estimates the quantities of waste that will be treated adequately either on-site in existing systems or off-site by facilities owned by the same company as the generator (i.e., captive facilities). The resulting estimates of required commercial capacity are then compared to estimates of available commercial capacity. If adequate commercial capacity exists, the waste is restricted from further land disposal before meeting the LDR treatment standards. If adequate capacity does not exist, RCRA section 3004(h)(2) authorizes EPA to grant a national capacity variance for the waste for up to two years or until adequate alternative treatment capacity becomes available, whichever is sooner.

B. Capacity Analysis Results Summary

The D.C. Circuit Court decision vacated the prohibition on land disposal of this waste. EPA therefore needs to make a capacity analysis determination for K088 due to the (nominally) new prohibition of this waste.

As indicated in the Background Documents for Capacity Analysis for Land Disposal Restrictions ⁸, an accurate projection of annual generation of K088 is difficult to develop. Primary aluminum production rates B one of the key determinants of K088 generation B vary from year to year. Other factors include the differences between potliners in terms of their useful life spans, the lag time between aluminum production and waste generation, and the one-time increases in potliner generation due to production starts and stops. Thus, for the purpose of comparing required treatment capacity to available capacity, EPA combined all the data presented in the Capacity Background Document to estimate that approximately 117,000 tons per year of K088 in the U.S. may require off-site alternative treatment. (See memo to this final rule's docket.)

\8\ Background Document for Capacity Analysis for Land Disposal Restrictions--Phase III--Decharacterized Wastewaters, Carbamate Wastes, and Spent Potliners (Final Rule, February

1996, Volume I Capacity Analysis Methodology and Results, pages 4-5 to 4-8); Background Document for Capacity Analysis Update for Land Disposal Restrictions--Phase III: Spent Aluminum Potliners (Final Rule, July 1997). to the Land Disposal Restrictions Phase III--Emergency Extension of the K088 Capacity Variance; Final Rule (62 FR 37694, July 14, 1997).

When estimating the available treatment or recovery capacity, the Agency includes the capacity currently available and operating in its analysis if the facility can meet all treatment standards, including the new treatment standard for arsenic in K088 waste. Available treatment capacity for K088 could vary due to several factors, such as the feed rate of the waste into the treatment unit, downtime of the units, the number of units that will be able to accept K088, and the amount of retreatment needed. Considering these factors, EPA estimates that approximately 120,000 tons per year of capacity could be available for treating K088. (See the Capacity Background Document for detailed analysis and Reynolds' comment to K088 NODA, 63 FR 41536, August 4, 1998.) In addition, one other commercial facility indicated that its treatment process is expected to begin operation sometime this year. Also, additional technologies as mentioned in Section III of this rule are under development and, therefore, additional treatment or recovery capacity may come on-line at on-site or off-site facilities for K088 waste.

Based on the results of the Agency's capacity analysis, adequate commercially available treatment (or recovery) capacity does currently exist for K088 waste. The largely-identical existing prohibition and treatment standards are still in effect, so there are no logistical barriers to immediate compliance. Therefore, LDR treatment standards will become effective immediately for the waste covered under this rule. (See RCRA section 3004(h)(1); land disposal prohibitions must take effect immediately when there is sufficient protective treatment capacity for the waste available).

V. Compliance and Implementation

A. Applicability of Rule in Authorized States

Under section 3006 of RCRA, EPA may authorize qualified States to administer and enforce the RCRA program within the State. Following authorization, EPA retains enforcement authority under sections 3008, 3013, and 7003 of RCRA, although authorized States have primary enforcement responsibility. The standards and requirements for authorization are found in 40 CFR part 271.

Prior to the Hazardous and Solid Waste Amendments (HSWA) of 1984, a State with final authorization administered its hazardous waste program in lieu of EPA administering the Federal program in that State. The Federal requirements no longer applied in the authorized State, and EPA could not issue permits for any facilities that the State was authorized to permit. When new, more stringent Federal requirements were promulgated or enacted, the State was obligated to enact equivalent authority within specified time frames. New Federal requirements did not take effect in an authorized State until the State adopted the requirements as State law.

In contrast, under RCRA section 3006(g), new requirements and prohibitions imposed by HSWA take effect in authorized States at the same time that they take effect in unauthorized States. EPA is directed to carry out these requirements and prohibitions in authorized States, including the issuance of permits, until the State is granted authorization to do so.

Today's rule is being promulgated pursuant to sections 3004 (g)(4) and (m) of RCRA. Therefore, the Agency is adding today's rule to Table 1 in 40 CFR 271.1(j), which identifies the Federal program requirements that are promulgated pursuant to HSWA. This rule is therefore effective in all states immediately pursuant to RCRA section 3006(g). States may apply for final authorization for the HSWA provisions in Table 1, as discussed in the following section of this preamble.

B. Effect on State Authorization

As noted above, EPA will implement today's rule in authorized States until they modify their programs to adopt these rules and the modification is approved by EPA. Because today's rule is promulgated pursuant to HSWA, a State submitting a program modification may apply to receive interim or final authorization under RCRA section 3006(g)(2) or 3006(b), respectively, on the basis of requirements that are substantially equivalent or equivalent to EPA's. The procedures and schedule for State program modifications for final authorization are described in 40 CFR 271.21. All HSWA interim authorizations will expire January 1, 2003. (See Sec. 271.24 and 57 FR 60132, December 18, 1992.)

VI. Regulatory Requirements

A. Regulatory Impact Analysis Pursuant to Executive Order 12866

Executive Order No. 12866 requires agencies to determine whether a regulatory action is "significant." The Order defines a "significant" regulatory action as one that "is likely to result in a rule that may: (1) have an annual effect on the economy of \$100 million or more or adversely affect, in a material way, the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities; (2) create serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients; or (4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order."

The Agency estimated the costs of today's final rule to determine if it is a significant regulation as defined by the Executive Order. Because the treatment standard for K088 promulgated in the Phase III final rule has remained in effect and unchanged except for arsenic and fluoride, treatment costs for spent aluminum potliner have been accounted for in the Phase III final rule rather than today's final rule. Accordingly, EPA believes that there are no costs

associated with today's final rule. (According to the Court, none of the standards measured by means other than TCLP were affected by the ruling, 139 F.3d at 923, so no costs should be attributed to treating these constituents under this rule in any case.) However, even in the event that treatment costs are attributed to today's final rule, the upper bound treatment estimate of \$42 million is not economically significant according to the definition in E.O. 12866. The Agency has, however, determined that this rule is significant for novel policy reasons.

Discussion of the methodology used for estimating the costs and economic impacts attributable to today's final rule for K088 wastes may be found in the background document ``Economic Assessment for Retention of LDR Treatment Standard for Spent Aluminum Potliner (K088) and Evaluation of Draft Groundwater Pathway Analysis For Aluminum Potliners (K088)" which was placed in the docket for today's final rule.

1. Methodology Section

The Agency examined reported values for K088 generation from the prior Agency estimates in the Phase III LDR final rule to estimate the volumes of K088 affected by today's rule, to determine the national level incremental costs (for both the baseline and post-regulatory scenarios), economic impacts (including first-order measures such as the estimated percentage of compliance cost to industry or firm revenues).

2. Results

a. Volume Results. Spent potliners (SPL) are generated in large volumes ranging from 95,000 to 125,000 tons annually.⁹ EPA estimated an average of approximately 120,000 tons annually for purposes of assessing cost and economic impacts from today's final rule. This estimated generation volume for K088 is greater than the estimate used in the capacity section because it includes not only volumes requiring alternative treatment, but also volumes currently undergoing treatment.

\\9\\ Background Document for Capacity Analysis for Land Disposal Restrictions, Phase III
(February 1996, Volume I, pages 4-5 to 4-8)

b. Cost Results. As stated above, because this rule only modifies the treatment standard for arsenic, the Agency believes that this rule does not impose incremental treatment costs associated with treating K088. EPA notes that analytical costs associated with sampling treated spent aluminum potliner may actually decrease because the cost of completing a totals analysis for arsenic is less than the comparable cost per sample of a TCLP analysis.¹⁰ For purposes of comparison, the Agency has estimated treatment costs for K088. If annual treatment costs were attributed to today's rule, they would range from \$9.6 million to \$42 million. EPA previously estimated treatment costs between \$6.4 million and \$42 million for the LDR Phase III final rule. 61 FR 15566, 15591 (April 8, 1996). EPA notes that new K088 treatment technologies are currently being developed that may significantly lower K088 treatment costs nationally.¹¹ EPA does not believe that this final rule will create barriers to market entry for firms wishing to provide alternative treatment capacity for spent aluminum potliner. The Agency believes that the net effect of today's rule to modify the existing K088 treatment standard by changing the TCLP test for arsenic to a totals number is unlikely to burden alternative treatment processes currently under development for the treatment of spent aluminum potliner.

\\10\\ One commercial testing laboratory provided an estimate of \$40 per sample for an arsenic totals analysis. Today's final rule should lower testing costs overall because the \$40 cost of total test for arsenic is less expensive than the \$90 to \$140 that would be required to run a TCLP test for arsenic for a treated residue.

\11\ For example, previously Reynolds Metals Company has provided data indicating that the treatment and disposal cost of their process, though variable depending on a series of factors, is between \$200 and \$500 per ton. Personal Communication with Jack Gates, Vice-President, Reynolds Metals Company, September 28, 1994 as cited in Regulatory Impact Analysis of the Phase III Land Disposal Restrictions Final Rule, U.S. Environmental Protection Agency, Office of Solid Waste, February 15, 1996. Recently, Waste Management has quoted treatment and disposal charges at \$160 per ton for treatment capacity now being developed at its Arlington, Oregon facility. Letter from Mitchell S. Hahn, Manager, Environment Health and Safety, Waste Management Inc. to Paul A. Borst, Economist, USEPA, Office of Solid Waste, June 4, 1998. The Waste Management treatment and disposal charge is determined by subtracting the \$85 storage price from a new customer price of \$245 per ton. Transportation costs are not factored into this estimate. Of the \$160 per ton treatment and storage cost, \$80 per ton is attributable to treatment and \$80 is attributable to disposal. Personal Communication between Mitch Hahn, Chemical Waste Management, and Paul Borst, U.S.E.P.A. August 13, 1998.

c. Economic Impact Results. To estimate potential economic impacts resulting from today's proposed rule, EPA has used first order economic impacts measures such as the estimated costs of today's final rule as a percentage of affected firms' sales and/or revenues. When the annual costs of regulation are less than one percent of a firm's annual sales or revenues, this analysis presumes that the regulation does not pose a significant economic impact on the affected facilities absent information to the contrary. Because EPA does not view this rule as imposing costs, the Agency does not believe that this rulemaking imposes economic impacts on regulated entities. But even if treatment costs are attributed to this rulemaking, no significant economic impact will result. In 1996, U.S. primary aluminum producers sold 3.6 million metric tons of aluminum at an average market price of \$1400 per ton yielding total sales of \$5.04 billion.¹² The \$42 million upper bound of the treatment cost estimate represents only 0.8 percent of the total value of the aluminum sold by primary aluminum producers. It is likely, as discussed, that treatment costs will decrease as new firms develop commercial

technologies for K088. As a result, this final rule will not pose a significant economic impact on primary aluminum producers in the United States. More detailed information on this estimate can be found in the economic assessment placed into today's docket.

\12\ Mineral Commodity Summaries 1997, U.S. Department of the Interior, U.S. Geological Survey, February 1997, p. 18.

d. Benefits Assessment. EPA has not calculated benefits associated with the total limitation on arsenic in today's final rule. Because today's final rule promulgates a prohibition and treatment standard for K088 with modest changes from the previous treatment standard for K088, the Agency believes that there is only likely to be a modest risk reduction because most of the risk reduction has already been accounted for through the K088 treatment standard in the Phase III final rule (as has the cost of treatment), although, as noted earlier, the total arsenic standard will ensure the minimization of leachable arsenic, as shown by recent monitoring data. However, the Agency wishes to correct an error in previous groundwater risk analysis for K088 with respect to cyanide.

EPA's groundwater risk analysis for K088 completed for the Phase III rulemaking indicated that cyanide did not pose a risk to human health.¹³ A review of the analysis indicates that the analysis results may have underestimated groundwater risk from cyanides in potliners for a variety of reasons. First, the analysis modeled cyanide ion, CN-(CAS # 57-12-5), as the cyanide species being considered for mobilization.¹⁴ However, other data indicate that ferrocyanide, Fe(CN)₆⁴⁻ (CAS # 13408-63-4), rather than cyanide ion is the prevalent cyanide species in spent potliner leachate typically accounting for 89 percent of total cyanide present.¹⁵ This is significant because cyanide ion may be less persistent in the environment than ferrocyanide. Cyanide ion may decompose in soil environments through hydrolysis, biodegradation or other means. Ferrocyanide

is an extremely persistent cyanide species.¹⁶ Ferrocyanide mobility may be limited in soil but yet retains the ability to form more toxic forms of cyanide--either hydrogen cyanide or free cyanide decomposition products.¹⁷

\13\ Groundwater Pathway Analysis for Aluminum Potliners (K088), Draft, U.S. Environmental Protection Agency, Office of Solid Waste, February 16, 1996. Tables 3-2 and 3-3.

\14\ Ibid. p. 9.

\15\ F.M. Kimmerle, et al., ``Cyanide Destruction in Spent Potlining." Light Metals 1989, Proceedings of the Technical Sessions by the TMS Light Metals Committee, 117th TMS Annual Meeting. Phoenix Arizona, January 25-28, 1988 as cited in Jim Mavis, CH2M Hill, ``Aluminum Industry" in Pollution Prevention Handbook, ed. Thomas Higgins (Boca Raton: CRC Press, 1995), p.379.

\16\ Adrian Smith and Terry Mudder, Chemistry and Treatment of Cyanidation Wastes (London: Mining Journal Books Ltd, 1991) p.11.

\17\ U.S.E.P.A., Listing Background Document--Primary Aluminum Production/Spent Potliners from Primary Aluminum Production, p.7.

In addition, the groundwater risk analysis modeled K088 cyanide leachate concentrations in a manner lower than what real-world experience has shown. The analysis modeled approximate TCLP cyanide concentrations of 110 ppm.¹⁸ However, in its K088 listing background document, EPA noted slab liquor (the runoff from concrete slabs on which spent potliners were placed during open storage) total cyanide concentrations of 13,000 mg/L total cyanide, more than two orders of magnitude greater than leachate concentration used in the

modeling analysis.¹⁹ A second source reports typical cyanide concentrations in potliner leachate at 5000 ppm.²⁰ See also Docket Item P33F-S0049A data set J (column testing of untreated potliners with neutral extractant showing cyanide concentrations between 1325 and 2885 ppm.)

\18\ Groundwater Pathway Analysis, p.9.

\19\ Listing Background Document, p.5.

\20\ Kimmerle as cited in Mavis, supra note 6, p.379.

Third, EPA's groundwater analysis may have underestimated groundwater risk from cyanide by not accounting for high pH conditions caused by the alkalinity of the potliner itself. The analysis used a national distribution of pH values for the saturated zone parameters from EPA's STORET database. This national distribution modeled low (4.9), medium (6.8) and high (8.0) values. However, the pH of the saturated zone in a site where spent potliner is leaching may be substantially higher than the national distribution. Spent aluminum potliner typically has a pH of 12.3 to 12.6.²¹ Under these elevated pH conditions, volatilization of cyanide ion as hydrogen cyanide gas, and hydrolysis and biodegradation are limited so cyanide available to contaminate groundwater would not be attenuated (as initially incorrectly modeled).²²

\21\ Special Laboratory Report, Reynolds Metals Company, 1996.

\22\ Adrian Smith and Terry Mudder, Chemistry and Treatment of Cyanidation Wastes (London: Mining Journal Books Ltd, 1991) p.49, 64, and 82.

Finally, at least four damage incidents to groundwater from cyanides from disposed potliner demonstrate the potential of cyanide in this waste to contaminate groundwater. In EPA's listing background document for spent potliner, the Agency documents cyanide contamination of drinking water wells in Washington State from Kaiser Aluminum's Mead Works facility near the Spokane aquifer. Some drinking water wells had levels of cyanide of 1 ppm exceeding the maximum contaminant level (MCL) of 0.2 ppm.²³ In addition, cyanide concentrations in leachate from a landfill containing potliner at a primary aluminum smelter site on the National Priority List (NPL) ranged between 373 and 1280 ppm.²⁴ Additional damage incidents showing cyanide groundwater contamination caused by improper disposal of spent potliners are summarized at Docket item PH3F-S0015. EPA thus believes the risks of groundwater contamination due to potliner disposal were incorrectly understated in the earlier RIA, and hereby withdraws the earlier conclusions regarding the low possibility and nature of cyanide contamination. Moreover, given the long-term inability of Subtitle C disposal to fully contain hazardous wastes, see RIA for Phase III final rule at 4-13 (Feb. 1996); and Inyang and Tomassoni, Indexing of Long-Term Effectiveness of Waste Containment Systems for a Regulatory Impact Analysis, EPA OSW (Nov. 1992), and the demonstrated cyanide contamination of exceeding health-based levels of groundwater already caused by improper disposal of these wastes, EPA finds that disposal of untreated potliners does pose a risk of cyanide contamination of groundwater at levels harmful to human health.

\23\ K088 Listing Background Document, p.8.

\24\ Record of Decision, Martin Marietta Corp., RODS DATA, September 29, 1988.

B. Regulatory Flexibility

The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement and Fairness Act, 5 U.S.C. 601-612, generally requires an agency to conduct a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. However, the Agency has determined that this final rule is not subject to the Regulatory Flexibility Act (RFA) and, moreover, it will not have a significant economic impact on a substantial number of small entities.

First, by its terms, the RFA applies only to rules subject to notice-and-comment rulemaking requirements under the Administrative Procedure Act (APA) or any other statute. Today's rule is not subject to notice and comment requirements under the APA or any other statute. Although today's rule is subject to the APA, the Agency has invoked the "good cause" exemption under APA section 553(b). As discussed below, the good cause exemption provides the notice and comment rulemaking requirements of the APA do not apply to a rulemaking when an agency finds them to be impracticable, unnecessary or contrary to the public interest.

Second, the Agency nonetheless has assessed the potential of this rule to adversely impact small entities. The Agency finds that this final rule does not have the potential to adversely impact small entities. As discussed above, today's final rule does not impose incremental costs to regulated entities. Also, the Agency has evaluated K088 treatment costs previously accounted for under the Phase III final rule and determined that even if these costs were attributed to today's final rule, they would not exceed 1 percent of the sales of small entities subject to this final rule. More information on this analysis can be found in the background document "Economic Assessment for Retention of LDR Treatment Standard for Spent Aluminum Potliner (K088) and Evaluation of Draft Groundwater Pathway Analysis For Aluminum Potliners (K088)" placed in the public docket.

C. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Pub. L. No. 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Under Section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures to State, local, and tribal governments, in the aggregate, or to the private sector, of \$100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

EPA has determined that this rule does not include a Federal mandate that may result in estimated costs of \$100 million or more to either State, local, or tribal governments in the aggregate. The rule would not impose any federal intergovernmental mandate because it imposes no enforceable duty upon State, tribal or local governments. States, tribes and local governments would have no compliance costs under this rule. It is expected that states will adopt similar rules, and submit those rules for inclusion in their authorized RCRA programs, but they have no legally enforceable duty to do so. For the same reasons, EPA also has determined that this rule contains no regulatory requirements that might significantly or uniquely affect small governments. In addition, as discussed above, the private sector is not expected to incur costs exceeding \$100

million. By these findings, EPA has fulfilled the requirement for analysis under the Unfunded Mandates Reform Act.

D. Executive Order 12875: Enhancing the Intergovernmental Partnership

To reduce the burden of Federal regulations on States and small governments, President Clinton issued Executive Order 12875 on October 26, 1993, entitled ``Enhancing the Intergovernmental Partnership." Under Executive Order 12875, EPA may not issue a regulation that is not required by statute unless the Federal Government provides the necessary funds to pay the direct costs incurred by the State and small governments or EPA provides to the Office of Management and Budget both a description of the prior consultation and communications the agency has had with representatives of State and small governments and a statement supporting the need to issue the regulation. In addition, Executive Order 12875 requires EPA to develop an effective process allowing elected and other representatives of State and small governments ``to provide meaningful and timely input in the development of regulatory proposals containing significant unfunded mandates."

For the reasons described above, today's final rule will not impose any enforceable duty or contain any unfunded mandate upon any State, local, or tribal government; therefore Executive Order 12875 does not apply to this action.

E. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

The Executive Order 13045, entitled ``Protection of Children from Environmental Health Risks and Safety Risks (62 FR 19885, April 23, 1997), applies to any rule that EPA determines (1) ``economically significant" as defined under Executive Order 12866, and (2) the environmental health or safety risk addressed by the rule has a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety

effects of the planned rule on children; and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency. This final rule is not subject to E.O. 13045 because this is not an economically significant regulatory action as defined by E.O. 12866, and because the Agency does not have reason to believe the environmental health or safety risks addressed by this action present a disproportionate risk to children. The Agency has concluded this because this rulemaking establishes treatment standards for hazardous constituents in spent aluminum potliner that minimize both short-term and long-term threats to human health and the environment. The environmental health risks or safety risks addressed by this action do not have a disproportionate effect on children.

F. Environmental Justice E.O. 12898

EPA is committed to addressing environmental justice concerns and is assuming a leadership role in environmental justice initiatives to enhance environmental quality for all residents of the United States. The Agency's goals are to ensure that no segment of the population, regardless of race, color, national origin, or income bears disproportionately high and adverse human health and environmental impacts as a result of EPA's policies, programs, and activities, and that all people live in clean and sustainable communities. In response to Executive Order 12898 and to concerns voiced by many groups outside the Agency, EPA's Office of Solid Waste and Emergency Response formed an Environmental Justice Task Force to analyze the array of environmental justice issues specific to waste programs and to develop an overall strategy to identify and address these issues (OSWER Directive No. 9200.3-17).

Today's final rule covers K088 spent potliner wastes from primary aluminum operations. It is not certain whether the environmental problems addressed by this rule could disproportionately affect minority or low income communities due to the location of primary aluminum operations. However, because today's final rule establishes treatment standards for K088 being land disposed, the Agency does not believe that today's rule will increase risks from K088. Indeed, as discussed earlier, these treatment standards will ensure that risks to human

health and the environment are minimized for all communities. It is, therefore, not expected to result in any disproportionately negative impacts on minority or low income communities relative to affluent or non-minority communities.

G. Paperwork Reduction Act

To the extent that this rule imposes any information collection requirements under existing RCRA regulations promulgated in previous rulemakings, those requirements have been approved by the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq., and have been assigned OMB control numbers 2050-120 (ICR no. 1573, Part B Permit Application); 2050-120 (ICR 1571, General Facility Standards); 2050-0028 (ICR 261, Notification to Obtain an EPA ID); 2050-0034 (ICR 262, Part A Permit Application); 2050-0039 (ICR 801, Hazardous Waste Manifest); 2050-0035 (ICR 820, Generator Standards); and 2050-0024 (ICR 976, Biennial Report).

H. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Pub. L. No. 104-113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

EPA is not aware of existing voluntary consensus standards that could be used for treatment standards of spent aluminum potliner. EPA believes that such voluntary consensus standards are therefore unavailable. This rulemaking also involves environmental monitoring or

measurement. As stated above, this final rule promulgates a revised treatment standard for arsenic in nonwastewater forms of K088, based on a total recoverable arsenic concentration from strong acid digestion as defined by EPA SW-846 Method 3050, 3051 or the equivalent. Consistent with the Agency's Performance Based Measurement System (PBMS), EPA has decided not to require the use of specific, prescribed analytic methods. Rather, the rule will allow the use of any method that meets the prescribed performance criteria. The PBMS approach is intended to be more flexible and cost-effective for regulated entities. It is also intended to encourage innovation in analytical technology and improve data quality. EPA is not precluding the use of any method, whether it constitutes a voluntary consensus standard or not, as long as it meets the performance criteria specified.

I. Executive Order 13084: Consultation and Coordination With Indian Tribal Governments

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments. If the mandate is unfunded, EPA must provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected and other representatives of Indian tribal governments ``to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

Today's rule does not significantly or uniquely affect the communities of Indian tribal governments. Aluminum potliners are not currently generated or treated on any known Indian tribal lands. Today's rule does not create a mandate on State, local or tribal governments. The rule

does not impose any enforceable duties on these entities. Accordingly, the requirements of section 3(b) of Executive Order 13084 do not apply to this rule.

J. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 et seq., as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. Section 808 allows the issuing agency to make a rule effective sooner than otherwise provided by the CRA if the agency makes a good cause finding that notice and public procedure is impracticable, unnecessary or contrary to the public interest. This determination must be supported by a brief statement. 5 U.S.C. 808(2). In the following section, EPA has made such a good cause finding, including the reasons therefore, and established an effective date of September 21, 1998. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the Federal Register. This action is not a "major rule" as defined by 5 U.S.C. 804(2).

VII. Good Cause for Immediate Final Rule

Under the Administrative Procedure Act (APA), 5 U.S.C. 553(b)(B), an agency may forego notice and comment in promulgating a rule when the agency for good cause finds (and incorporates the finding and a brief statement of the reasons for that finding into the rule) that notice and public comment procedures are impracticable, unnecessary, or contrary to the public interest. For the reasons set forth below, EPA finds good cause to conclude that notice and comment would be unnecessary and contrary to the public interest, and therefore is not required under the APA.

EPA believes that notice and opportunity for comment has been provided here, albeit not through the means of a proposed rule. The Agency has been in protracted discussions with the regulated community both directly and through court pleadings. Therefore, members of the regulated community have had opportunity to comment and make their views known. Most recently, the Agency provided for specific notice and comment on the data to be used in the development of a standard based on total arsenic content in treatment residue. See 63 FR 41536, August 4, 1998. EPA received comments addressing every aspect of these standards in response to this document, and is responding to these comments in this preamble and also in a separate Response to Comment Background Document. Furthermore, other than for the arsenic standard, this document makes conforming changes that reinstate and maintain the current standards which were already the subject of exhaustive notice and comment in both the Phase III rulemaking and in response to the January 14 document extending the national capacity variance date. Petitioners in the K088 litigation, for example, filed a multitude of different comments in response to these various documents. Further opportunity to comment therefore is not necessary.

Consequently, EPA today is preserving the core of the K088 treatment standards promulgated in the Phase III rule by ensuring that the K088 wastes are prohibited from land disposal unless they first meet the treatment standards in this rule. At the same time, EPA is eliminating the standards found to be arbitrary by the Court. The Agency also concludes that this action must be taken immediately and that notice and comment would be contrary to the public interest in these special circumstances. Delay past the projected date of issuance of the Court's mandate (September 24, 1998) could result in land disposal of untreated spent potliners, contrary to explicit statutory command that land disposal of this waste be prohibited. (See as well the earlier discussion in this Preamble of the need to assure that this prohibition does not lapse.) For these reasons, EPA believes that there is good cause to issue this final rule immediately without prior notice and comment. This is not to say that EPA would, or could, invoke this type of good cause rationale whenever contemplating promulgation of LDR prohibitions and treatment standards. However, in the present circumstances, where the waste already is prohibited and untreated land disposal of the waste has therefore ended, it appears especially important to avoid

backsliding to a regime of untreated land disposal.

For the same reasons, EPA finds, for purposes of 5 U.S.C. 553(d), that there is good cause to make the rule effective immediately. In any case, the statute indicates that LDR prohibitions are to take effect immediately. See RCRA section 3004(h)(1). (Prohibitions on land disposal are effective immediately so long as there is adequate protective treatment capacity available at that time.)

List of Subjects

40 CFR Part 268

Environmental protection, Hazardous waste, Reporting and recordkeeping requirements.

40 CFR Part 271

Environmental protection, Administrative practice and procedure, Confidential business information, Hazardous material transportation, Hazardous waste, Indians-lands, Intergovernmental relations, Penalties, Reporting and recordkeeping requirements, Water pollution control, Water supply.

Dated: September 21, 1998.

Carol M. Browner,

Administrator.

For the reasons set out in the preamble, title 40, chapter I of the Code of Federal Regulations is amended as follows:

1. The authority for part 268 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6921, and 6924.

2. Section 268.39 is amended by revising paragraphs (c) to read as follows:

Sec. 268.39 Waste specific prohibitions--spent aluminum potliners; and carbamate wastes.

* * * * *

(c) On September 21, 1998, the wastes specified in 40 CFR 261.32 as EPA Hazardous Waste number K088 are prohibited from land disposal. In addition, soil and debris contaminated with these wastes are prohibited from land disposal.

* * * * *

3. Section 268.40 is amended by revising the entry for K088 in the table of Treatment Standards to read as follows: (The footnotes are republished without change.)

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[GRAPHIC] [TIFF OMITTED] TR24SE98.037

[GRAPHIC] [TIFF OMITTED] TR24SE98.038

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Footnotes to Treatment Standard Table 268.40

1 The waste descriptions provided in this table do not replace waste descriptions in 40 CFR part 261. Descriptions of Treatment/Regulatory Subcategories are provided, as needed, to distinguish

between applicability of different standards.

2 CAS means Chemical Abstract Services. When the waste code and/or regulated constituents are described as a combination of a chemical with its salts and/or esters, the CAS number is given for the parent compound only.

3 Concentration standards for wastewaters are expressed in mg/L and are based on analysis of composite samples.

4 All treatment standards expressed as a Technology Code or combination of Technology Codes are explained in detail in 40 CFR 268.42 Table 1--Technology Codes and Descriptions of Technology-Based Standards.

5 Except for Metals (EP or TCLP) and Cyanides (Total and Amenable) the nonwastewater treatment standards expressed as a concentration were established, in part, based upon incineration in units operated in accordance with the technical requirements of 40 CFR Part 264, Subpart O, or Part 265, Subpart O, or based upon combustion in fuel substitution units operating in accordance with applicable technical requirements. A facility may comply with these treatment standards according to provisions in 40 CFR 268.40(d). All concentration standards for nonwastewaters are based on analysis of grab samples.

* * * * *

7 Both Cyanides (Total) and Cyanides (Amenable) for nonwastewaters are to be analyzed using Method 9010 or 9012, found in ``Test Methods for Evaluating Solid Waste, Physical/Chemical Methods'', EPA Publication SW-846, as incorporated by reference in 40 CFR 260.11, with a sample size of 10 grams and a distillation time of one hour and 15 minutes.

* * * * *

PART 271--REQUIREMENTS FOR AUTHORIZATION OF STATE HAZARDOUS WASTE PROGRAMS

4. The authority citation for Part 271 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), and 6926.

5. Section 271.1(j) is amended by adding the following entries to Table 1 and Table 2 in chronological order by date of publication to read as follows.

Sec. 271.1 Purpose and scope.

* * * * *

(j) * * *

TABLE 1--REGULATIONS IMPLEMENTING THE HAZARDOUS AND SOLID WASTE AMENDMENTS OF 1984

Federal Register							
Promulgation date	Title of Regulation				reference	Effective date	
	*	*	*	*	*	*	*
Sept. 21, 1998	Treatment Standards Sept. 21, 1998 for Hazardous Waste K088 numbers].						
	*	*	*	*	*	*	*

TABLE 2--SELF-IMPLEMENTING PROVISIONS OF THE SOLID WASTE AMENDMENTS OF 1984

Self-implementing							
Effective date	provision				RCRA citation	Federal Register reference	
	*	*	*	*	*	*	*
Sept. 21, 1998	Prohibition on land				3004(g)(4)(C) and	Sept. 24, 1998 disposal of K088	

3004(m). wastes, and prohibition on land disposal of radioactive waste
mixed with K088 wastes, including soil and debris.

* * * * *

[FR Doc. 98-25643 Filed 9-23-98; 8:45 am]

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Appendix D
Ormet Corporation Raw Data

This appendix to the background document presents sampling and performance data measured to support calculated treatment standard values for fluoride, amenable cyanide, and total cyanide. The analytical data used to determine the treatment standards were gathered from samples taken at the Ormet Corporation treatment facility in Hannibal, Ohio in June 1999. During the June 15, 1999 sampling event, EPA collected and analyzed four grab samples (i.e., a single sample of material was collected from a process stream) of untreated spent potliner and vitrified, glass residue. In a similar manner, four samples each of untreated waste and vitrified product were collected on June 22, 1999 and analyzed, as well as four samples of baghouse dust. Refer to Table D-1 for a detailed description of the analytical methods followed to measure the sample concentrations. Presented on the following pages are laboratory data of the four total samples of untreated spent potliner and vitrified, glass residue collected only on June 15, 1999. Data collected on June 22, 1999 has been included in Appendix F as an additional data set included in the performance analysis of Ormet's treatment system.

For each round of sample analysis, a contract laboratory performed analysis of laboratory method blanks using distilled-reagent water and a clean sand matrix to represent an aqueous and solid matrix, respectively. The laboratory generally applied detection limits reported in the SW-846 methodologies, and periodically conducted analysis of control standards to determine if the resulting detection limit calculated from these check standards were at least as low as the reported values.

For each round of sample analysis, the laboratory also performed analysis of laboratory control spikes. These samples were prepared from distilled water (for aqueous matrix) or sand (for solid matrix), and spiked with known concentrations of the target analytes. The control standards were extracted and analyzed in the same manner as an actual waste sample in order to determine the percent recovery for each spiked constituent using an interference-free sample matrix. In addition, field samples of each matrix type were subjected to a matrix spike and matrix spike duplicate (MS/MSD) analysis in order to evaluate the effectiveness of the extraction and analysis techniques based on the rigorous QA/QC requirements of the Land Disposal Program.

As with any group of samples and associated analyses, varying constituent concentrations

were found in the spent potliner residue, nonleachable glass product, and baghouse dust. The varying concentrations may be the effects of varied sampling locations within the influent, frit, or baghouse, or varied sampling locations within the laboratory sample jars. Varying concentrations of the glass product may also be the effects of process variability.

Although samples taken on both days were analyzed, and full sets of data that included MS/MSD data were generated, the QA/QC requirements of the Land Disposal Program pertaining to sample custody and transport were not met for samples taken on June 22, 1999. Chain of custody (COC) documentation was not received at the laboratory with the shipment of samples taken that day. A COC record should accompany samples at all times from the time of collection until receipt by the laboratory. This record represents the official documentation for all transfers of the sample custody until the samples arrive at the laboratory. Without this documentation the sample integrity and analytical data validity are questionable. In addition, a further review of the elevated total and leachable fluoride concentrations, for the treated and untreated material, gathered on June 22, 1999 indicates the treatment process was functioning much differently as compared to process runs on June 15, 1999. There was also a much greater degree of concentration variability in samples taken on June 22, 1999. However, the laboratory results are considered valid based on compliant analytical precision and accuracy data and acceptable laboratory control standard recoveries. Also, a review of laboratory procedures and operating parameters observed at Ormet offer no explanation as to why the data show high fluoride concentrations in the treated waste samples. Since a record of the sampling times and sequence was not recorded on a COC document for sampling on June 22, 1999, the possibility of field contamination cannot be ruled out and the sample results for this day should be considered of limited value. This data is simply included in Appendix F as supplemental data for the purpose of evaluating the performance of Ormet's treatment system. The treatment standards calculations presented in chapter 4 of the background document are, therefore, based on treated, glass residue data from only samples gathered on June 15, 1999. The Agency also feels it is necessary to gather additional data in support of the proposed standards calculated in this document to alleviate the concerns of samples collected on June 22, 1999.

Table D-1. Summary of Laboratory Analyses

Parameter	Method	Target Method Detection Limit ¹	Precision ¹ (%RPD)	Accuracy ¹ (%R) Warning Limits	Accuracy ¹ (%R) Acceptance Limits	Completeness ¹
Total Fluoride ⁴	SM 4500-F/SW-846 Method 9056	5 mg/kg ²	< 25%	50-125%	25-150%	90%
PAHs ⁵	SW-846 Method 8270B	330 µg/kg ²	< 25%	50-125%	25-150%	90%
Total Arsenic	SW-846 Method 3052/6010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
Total Acid-Soluble Arsenic	SW-846 Method 3051/6010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
Total Cyanide	SW-846 Method 9010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
Total Amenable Cyanide	SW-846 Method 9010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
pH	SW-846 Method 9045C (Soil pH)	NA	< 25%	NA	NA	90%
Percent solids/moisture ⁶	—	NA	< 25%	NA	NA	90%
TCLP ⁷	SW-846 Method 1311	NA ³	< 25%	50-125%	NA	90%
EDTA TCLP ⁸	SW-846 Method 1311	NA ³	< 25%	50-125%	NA	90%
Leachable Fluoride	ASTM D3987	10 µg/L	<25%	50-125%	25-150%	90%
Modified Leachable Fluoride ⁹	ASTM D3987	10 µg/L	<25%	50-125%	25-150%	90%
CA WET Metals ¹⁰	CA Waste Extraction Test	NA ³	<25%	50-125%	25-150%	90%
Modified CA WET Metals ¹¹	CA Waste Extraction Test	NA ³	<25%	50-125%	25-150%	90%

¹Site-specific values will be developed from knowledge of the waste.

²Detection limits are specific to individual target analytes and the matrix sampled.

³Arsenic measurements must achieve detection limits of 0.01 mg/L or better.

⁴Due to the high levels of fluoride expected in at least one sample matrix, the laboratory was given the option of reducing the sample size suggested for analysis.

⁵PAH compounds include: Acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

⁶Percent solids is determined by drying a sample in an oven at 60°C and weighing the residue.

⁷For the K088 samples, the resulting leachate was analyzed for antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

⁸A modification of SW-846 Method 1311 can be followed for Modified TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. In place of the acetate buffer, a 0.1 M EDTA solution at pH 5 is used as the leaching fluid. The resulting leachate was analyzed for the metals previously mentioned.

⁹The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste can also be determined using a modification of ASTM D3987 in which the leaching fluid is prepared using a NaOH solution at pH 11.5 to 12.5, in place of reagent water.

¹⁰The California Wet Extraction Test (CA WET) is performed for metals leachability testing. With this analysis, sample are generally tumbled in a 10:1 buffer solution of 0.2M sodium citrate for 48 hours. The resulting K088 leachate was analyzed for antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

¹¹A modified CA WET can also be performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The modification includes a 20:1 liquid to solid ratio with an 18 hour leaching period. The resulting leachate was for the same constituents mentioned previously.

TCLP Metals - Methods 1311, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/15/99	< .06	< .01	0.351	< .005	< .005	0.0170	0.003	< .0005	0.220	< .005	< .010	4.967
Glass for USEPA 2	6/15/99	< .06	< .01	0.292	< .005	< .005	0.0176	< .003	< .0005	0.187	< .005	< .010	4.961
Glass for USEPA 3	6/15/99	< .06	< .01	0.208	< .005	< .005	0.0154	0.0038	< .0005	0.229	0.0057	< .010	4.968
Glass for USEPA 4	6/15/99	< .06	< .01	0.406	< .005	< .005	0.0202	0.0039	< .0005	0.233	< .005	< .010	4.962
Duplicate Result		< .06	< .01	0.209	< .005	< .005	0.0162	0.0033	< .0005	0.234	0.0046	< .010	
Dup % RPD		NA	NA	0.5	NA	NA	5.1	14.1	NA	2.2	21.4	NA	
MS/MSD%		93.4/94.0	96.7/97.9	88.3/149.9	91.1/91.2	96.3/96.2	93.1/92.8	92.2/92.6	100.0/102.0	90.0/89.0	91.3/92.6	97.3/97.7	
Spike % RPD		0.7	1.3	30.4	0.1	0.1	0.3	0.4	1.7	1.1	1.4	0.4	
Spent Pot Liner 1	6/15/99	< .06	0.0476	0.749	0.0098	< .005	0.0129	< .003	< .0005	0.1270	0.0142	< .010	9.325
Spent Pot Liner 2	6/15/99	< .06	0.0440	0.444	0.0108	< .005	0.0157	< .003	< .0005	0.1380	0.0132	< .010	8.983
Spent Pot Liner 3	6/15/99	< .06	0.0436	0.466	0.0117	< .005	0.0163	< .003	< .0005	0.1250	0.0136	< .010	9.046
Spent Pot Liner 4	6/15/99	< .06	0.0484	0.609	0.0092	< .005	0.0142	< .003	< .0005	0.1740	0.0119	< .010	9.210

SW-846 Method 1311 was followed for TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The resulting leachate was analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Modified w/EDTA TCLP Metals - Methods 1311, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/15/99	< .06	0.0203	0.320	< .005	< .005	0.0412	0.0055	< .002	0.249	0.0555	< .01	5.311
Glass for USEPA 2	6/15/99	< .06	0.0227	0.269	< .005	< .005	0.0683	0.0099	< .002	0.286	0.0581	< .01	5.256
Glass for USEPA 3	6/15/99	< .06	0.0204	< .200	< .005	< .005	0.0412	0.0057	< .002	0.262	0.0596	< .01	5.214
Glass for USEPA 4	6/15/99	< .06	0.0231	< .200	< .005	< .005	0.0707	0.0084	< .002	0.371	0.0545	< .01	5.262
Duplicate Result		< .06	0.0216	< .200	< .005	< .005	0.0420	0.0075	< .002	0.264	0.0596	< .01	
Dup % RPD		NA	5.7	NA	NA	NA	1.9	27.3	NA	1.0	0.1	NA	
MS/MSD%		89.1/85.7	97.0/94.9	87.5/79.8	84.8/81.3	86.6/81.6	86.4/82.0	79.6/76.3	103.0/102.0	81.2/71.7	93.8/97.7	96.8/92.0	
Spike % RPD		3.9	2.0	4.9	4.1	6.0	4.4	4.2	0.8	5.2	3.3	5.1	
Spent Pot Liner 1	6/15/99	< .06	0.0788	3.360	< .005	< .005	0.107	0.145	< .002	0.244	0.0599	< .01	8.318
Spent Pot Liner 2	6/15/99	< .06	0.0765	3.110	< .005	< .005	0.113	0.171	< .002	0.255	0.0603	< .01	8.321
Spent Pot Liner 3	6/15/99	< .06	0.0788	3.950	< .005	< .005	0.124	0.181	< .002	0.275	0.0656	< .01	8.124
Spent Pot Liner 4	6/15/99	< .06	0.0755	3.240	< .005	< .005	0.112	0.167	< .002	0.257	0.0652	< .01	8.105

A modification of SW-846 Method 1311 was followed for Modified TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. In place of the acetate buffer, a 0.1 M EDTA solution at pH 5 was used as the leaching fluid. The resulting leachate was analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Waste Extraction Test Metals - Methods CA STLC, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/15/99	< .06	0.0311	0.315	< .01	< .025	0.150	< .015	< .002	0.850	0.0459	< .01	5.352
Glass for USEPA 2	6/15/99	< .06	0.0334	0.330	< .01	< .025	0.241	< .015	< .002	0.819	0.0474	< .01	5.329
Glass for USEPA 3	6/15/99	< .06	0.0520	0.258	< .01	< .025	0.165	< .015	< .002	1.060	0.0463	< .01	5.311
Glass for USEPA 4	6/15/99	< .06	0.0336	0.340	< .01	< .025	0.223	< .015	< .002	0.979	0.0413	< .01	5.308
Duplicate Result		< .06	0.0471	0.303	< .01	< .025	0.167	< .015	< .002	1.060	0.0431	< .01	
Dup % RPD		NA	9.9	15.9	NA	NA	1.0	NA	NA	0.4	7.1	NA	
MS/MSD%		98.1/95.2	101.6/101.9	103.8/95.3	90.4/89.3	93.8/93.1	97.0/95.0	95.4/92.9	88.8/92.7	94.6/95.4	107.3/105.9	93.9/93.4	
Spike % RPD		3.0	0.3	4.2	1.3	0.6	1.3	2.6	4.3	0.2	1.1	0.5	
Spent Pot Liner 1	6/15/99	< .06	0.123	0.745	< .01	< .025	0.161	< .015	< .002	0.155	0.0740	< .01	10.205
Spent Pot Liner 2	6/15/99	< .06	0.122	0.743	< .01	< .025	0.159	< .015	< .002	0.173	0.0806	< .01	10.133
Spent Pot Liner 3	6/15/99	< .06	0.113	0.609	< .01	< .025	0.153	< .015	< .002	0.174	0.0700	< .01	10.143
Spent Pot Liner 4	6/15/99	< .06	0.117	0.629	< .01	< .025	0.158	< .015	< .002	0.236	0.0658	< .01	10.090

The California Wet Extraction Test was performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The resulting leachate was analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Modified Waste Extraction Test Metals - Methods CA STLC-M, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/15/99	< .06	< .025	< .200	< .01	< .025	0.0543	< .015	< .002	0.284	0.0618	< .01	5.310
Glass for USEPA 2	6/15/99	< .06	< .025	< .200	< .01	< .025	0.0932	< .015	< .002	0.287	0.0703	< .01	5.154
Glass for USEPA 3	6/15/99	< .06	0.0334	< .200	< .01	< .025	0.0564	< .015	< .002	0.318	0.0616	< .01	5.216
Glass for USEPA 4	6/15/99	< .06	0.0266	< .200	< .01	< .025	0.102	< .015	< .002	0.400	0.0653	< .01	5.177
Duplicate Result		< .06	0.0257	< .200	< .01	< .025	0.0562	< .015	< .002	0.310	0.0630	< .01	
Dup % RPD		NA	26.1	NA	NA	NA	0.4	NA	NA	2.7	2.3	NA	
MS/MSD%		96.4/97.6	93.0/99.0	90.7/91.3	92.3/93.0	95.8/96.3	92.5/93.7	94.3/96.3	106.0/101.0	91.0/92.7	107.4/108.7	93.8/93.9	
Spike % RPD		1.3	5.5	0.6	0.7	0.5	1.0	2.0	5.0	0.8	0.9	0.1	
Spent Pot Liner 1	6/15/99	< .06	0.0858	2.690	< .01	< .025	0.221	< .015	0.007	0.297	0.0718	< .01	7.556
Spent Pot Liner 2	6/15/99	< .06	0.0892	4.270	0.0181	< .025	0.222	< .015	< .002	0.299	0.0479	< .01	7.608
Spent Pot Liner 3	6/15/99	< .06	0.103	3.590	0.0110	< .025	0.252	< .015	< .002	0.316	0.0838	< .01	7.813
Spent Pot Liner 4	6/15/99	< .06	0.0892	2.080	< .01	< .025	0.226	< .015	< .002	0.318	0.0722	< .01	7.153

A modified California Wet Extraction Test was also performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The modification included a 20:1 liquid to solid ratio with an 18 hour leaching period. The resulting leachate was for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Total PAHs - Method 8270B mg/kg

Sample ID	Sample	Acen- apthene	Anthra- cene	Benz (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (g,h,i) perylene	Benzo (k) fluor- anthene	Chrysene	Dibenz (a,h) anthracene	Fluor -anthene	Indeno (1,2,3-cd) pyrene	Phen- anthrene	Pyrene
Glass for USEPA 1	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Glass for USEPA 2	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Glass for USEPA 3	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Glass for USEPA 4	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
MS/MSD%		94.1/89.5	93.0/88.8	91.1/86.6	83.7/81.2	88.9/90.5	67.2/64.8	85.2/79.2	91.1/86.7	70.6/68.0	93.5/90.7	67.5/63.9	94.4/91.1	94.9/90.3
Spike % RPD		5.0	4.6	5.1	3.1	1.8	3.5	7.2	5.0	3.7	3.1	5.6	3.6	5.0
Spent Pot Liner 1	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Spent Pot Liner 2	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Spent Pot Liner 3	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Spent Pot Liner 4	6/15/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330

PAHs were analyzed using SW-846 Method 8270B. PAH compounds include: acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

General Chemistry - mg/kg

Sample ID	Sample Collection Date	Moisture (%)	Total Cyanide	Ammenable Cyanide	pH	Total Acid Soluble Arsenic	Total Arsenic
Glass for USEPA 1	6/15/99	5.0	< 0.5	< 0.5	8.00	< 2	< 2
Glass for USEPA 2	6/15/99	3.4	< 0.5	< 0.5	8.75	< 2	< 2
Glass for USEPA 3	6/15/99	3.4	< 0.5	< 0.5	8.19	< 2	< 2
Glass for USEPA 4	6/15/99	3.7	< 0.5	< 0.5	8.26	< 2	< 2
Duplicate Result			< 0.5	< 0.5	8.03	< 2	< 2
Dup % RPD			NA	NA	0.4	NA	NA
MS/MSD%			108.7/109.3	0.0/0.0		85.0/85.6	96.0/103
Spike % RPD			6.2	NA		0.7	7.1
Spent Pot Liner 1	6/15/99	< 2	714	421	12.68	< 2	4.0
Spent Pot Liner 2	6/15/99	< 2	578	281	12.66	< 2	3.1
Spent Pot Liner 3	6/15/99	< 2	690	303	12.75	< 2	3.3
Spent Pot Liner 4	6/15/99	< 2	707	282	12.83	< 2	3.5
Duplicate Result			729	293	12.79		
Dup % RPD			3.1	3.8	1.0		
MS/MSD%			1,640/1,620	101.6/97.3			
Spike % RPD			1.2	3.3			

Total and amenable cyanide values were measured using SW-846 9010B. Arsenic analyses using the traditional acid digestion (HN03) procedures will be identified as "total acid soluble arsenic". In order to more closely correlate these results to the total arsenic data, the microwave assisted technique (3051) will be employed.

Total arsenic will be determined using a microwave assisted digestion technique (3052) in which hydrofluoric acid is used to completely digest highly siliceous sample materials. Given the safety hazards and the instrumentation limitations with using this acid, if it can be demonstrated that the sample matrices are low in silica content, the laboratory will have the option of using the perchloric acid digestion technique according to Method 3052. However, the silica content of the treated waste is known to range from 10 - 40%, and in this case the laboratory should consider using boric acid to neutralize potential high fluoride digestate concentrations in order to protect quartz instrumentation parts.

Fluoride

Sample ID	Sample Collection Date	Leachable Fluoride (mg/L)	Moisture (%)	Leachable Fluoride (Initial pH)	Leachable Fluoride (Final pH)	Leachable Fluoride pH 11-5-12.5 (mg/L)	Leachable Fluoride pH 11-5-12.5 (Init pH)	Leachable Fluoride pH 11-5-12.5 (Final pH)	pH	Total Fluoride (mg/kg)	Total Fluoride Distilled (mg/kg)
Glass for USEPA 1	6/15/99	1.9	5.0	8.0	8.427	1.8	12.0	12.321	8.00	33.9	66.0
Glass for USEPA 2	6/15/99	2.3	3.4	8.8	9.272	2.1	12.0	12.328	8.75	41.8	242
Glass for USEPA 3	6/15/99	1.9	3.4	8.2	7.998	2.1	12.0	12.321	8.19	40.9	348
Glass for USEPA 4	6/15/99	2.5	3.7	8.2	8.967	2.0	12.0	12.276	8.26	37.4	275
Duplicate Result		1.8							8.03	32.2	
Dup % RPD		5.4							0.4	5.1	
MS/MSD%		110/110								94/81	
Spike % RPD		0.0								5.1	
Spent Pot Liner 1	6/15/99	3,210	< 2			3,560			12.68	66,400	
Spent Pot Liner 2	6/15/99	3,000	< 2			3,430			12.66	69,600	
Spent Pot Liner 3	6/15/99	3,070	< 2			3,470			12.75	57,700	
Spent Pot Liner 4	6/15/99	3,230	< 2			3,520			12.83	57,400	
Duplicate Result		3,030							12.79	70,900	
Dup % RPD		1.0							1.0	1.9	
MS/MSD%		104/105								109/92.5	
Spike % RPD		0.6								3.7	

The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste was determined using ASTM D3987. This procedure utilized reagent water as the leaching media.

The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste was determined using a modification of ASTM D3987 in which the leaching fluid is prepared using a NaOH solution at pH 11.5 to 12.5.

Appendix E
Detailed Treatment Standard Calculations

Amenable Cyanide Treatment Standard Calculations (Treated Glass, Numbers 1-4)

Amenable Cyanide - Treated

Analytical Data							
	Sample Date	Reported Sample Concentration (mg/kg)	Reported Duplicate Concentration (mg/kg)	Concentration Used (mg/kg)	ln(Conc.)	MS/MSD % Recovery	Z Score
Glass for USEPA #1	06/15/99	<0.5	<0.05	0.50	-0.69	0/0	0.00
Glass for USEPA #2	06/15/99	<0.5	Not given	0.50	-0.69	--	0.00
Glass for USEPA #3	06/15/99	<0.5	Not given	0.50	-0.69	--	0.00
Glass for USEPA #4	06/15/99	<0.5	Not given	0.50	-0.69	--	0.00
Count				4.00	4.00	--	
Total				2.00	-2.77	--	
Average				0.50	-0.69	--	
Standard Deviation				0.00	0.00	--	

	Conc.	ln(Conc.)
Total	2.00	-2.77
Average	0.50	-0.69
Standard Deviation	0.00	0.00
VF		2.80
ACF	MS=0%	1.00
Standard	mg/kg	1.40

$$VF = \frac{C_{99}}{C_{99}}$$

Mean (VF=2.8 if all data are ND)

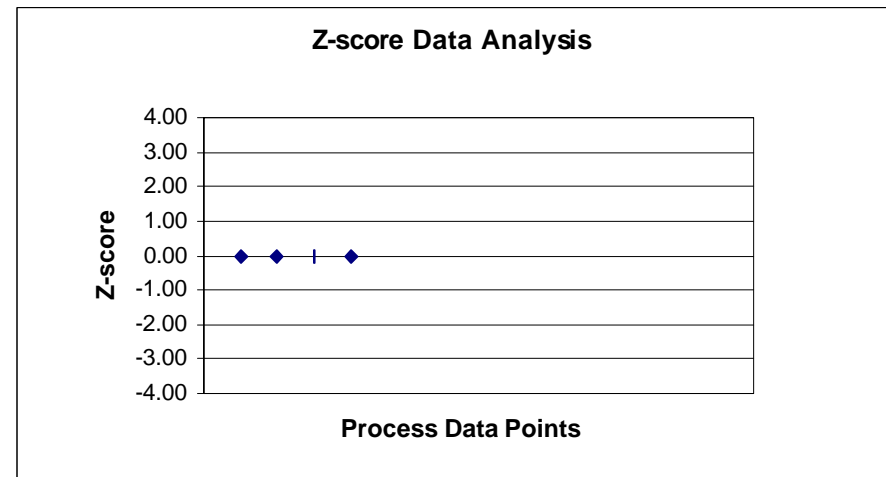
where, $C_{99} = \text{Exp}[y + 2.33 S_y]$

y = Mean of log-transformed concentrations

Sy = Standard Deviation of log-transformed concentrations

ACF = 1.0 / low est acceptable % recovery value =
= 1.0 / 0% (used 1.00 for % recovery)

Treatment Standard = ACF * Average Concentration * VF
= 1.0 * 0.50 mg/kg * 2.80 = 1.40



*For data that is normally distributed, 99.5 percent of the measurements will have a **Z-score** between -2.0 and 2.0. Any data point outside this range is not considered to be representative of the population from which the data points are drawn. Z -score = (Data Point Value - Average) / Standard Deviation.

Total Cyanide Treatment Standard Calculations (Treated Glass, Numbers 1-4)

Total Cyanide - Treated

Analytical Data							
	Sample Date	Reported Sample Concentration (mg/kg)	Reported Duplicate Concentration (mg/kg)	Concentration Used (mg/kg)	ln(Conc.)	MS/MSD % Recovery	Z Score
Glass for USEPA #1	06/15/99	<0.5	not given	0.50	-0.69	--	0.00
Glass for USEPA #2	06/15/99	<0.5	not given	0.50	-0.69	--	0.00
Glass for USEPA #3	06/15/99	<0.5	not given	0.50	-0.69	--	0.00
Glass for USEPA #4	06/15/99	<0.5	<0.5	0.50	-0.69	108.7/109.3	0.00
Count				4.00	4.00	--	
Total				2.00	-2.77	--	
Average				0.50	-0.69	--	
Standard Deviation				0.00	0.00	--	

$$VF = \frac{C_{99}}{\text{Mean}} \quad (VF=2.8 \text{ if all data are ND})$$

	Conc.	ln(Conc.)
Total	2.00	-2.77
Average	0.50	-0.69
Standard Deviation	0.00	0.00
VF		2.80
ACF	MS=108.7%	0.92
Standard	mg/kg	1.29

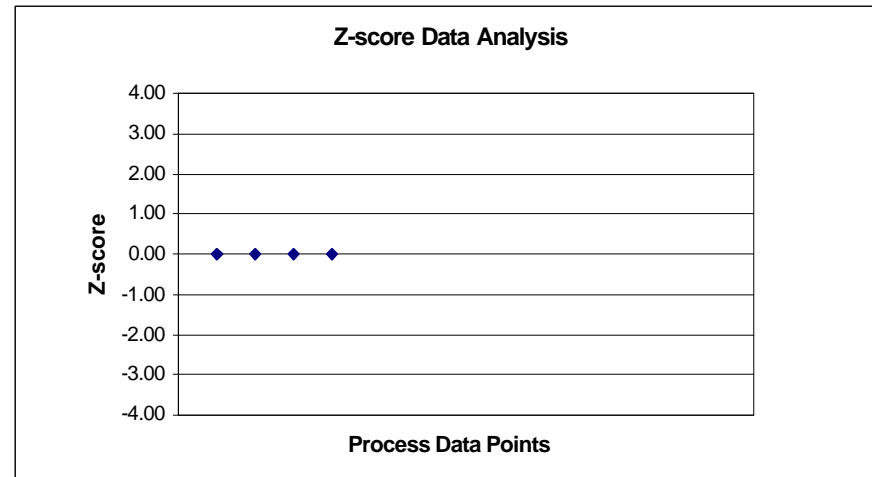
where, $C_{99} = \text{Exp}[y+2.33 Sy]$

y = Mean of log-transformed concentrations

Sy = Standard Deviation of log-transformed concentrations

$$\text{ACF} = 1.0 / \text{low est acceptable \% recovery value} = 1.0 / 108.7\%$$

$$\text{Treatment Standard} = \text{ACF} * \text{Average Concentration} * VF = 0.92 * 0.76 \text{ mg/kg} * 2.80 = 1.29$$



*For data that is normally distributed, 99.5 percent of the measurements will have a **Z-score** between -2.0 and 2.0. Any data point outside this range is not considered to be representative of the population from which the data points are drawn. $Z\text{-score} = (\text{Data Point Value} - \text{Average}) / \text{Standard Deviation}$.

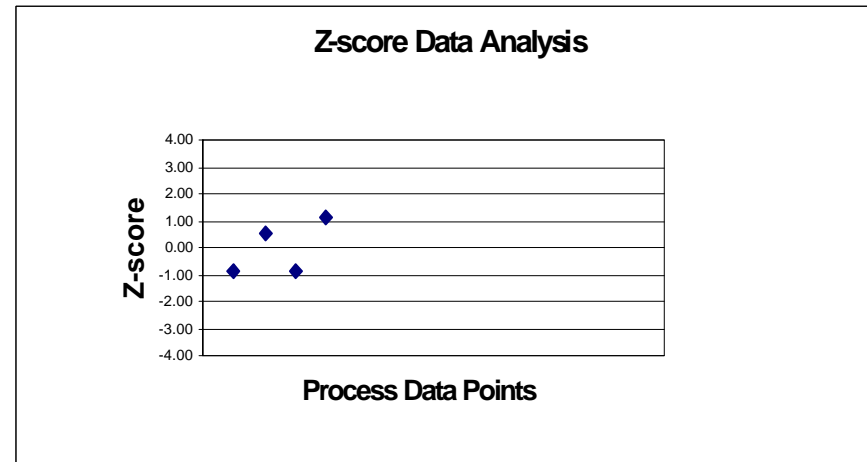
Leachable Fluoride Treatment Standard Calculations (Treated Glass, Numbers 1-4)

Leachable Fluoride - Treated

Analytical Data							
	Sample Date	Reported Sample Concentration (mg/L)	Reported Duplicate Concentration (mg/L)	Concentration Used (mg/L)	ln(Conc.)	MS/MSD % Recovery	Z Score
Glass for USEPA #1	06/15/99	1.90	1.80	1.90	0.64	110/110	-0.84
Glass for USEPA #2	06/15/99	2.30	Not given	2.30	0.83	--	0.54
Glass for USEPA #3	06/15/99	1.90	Not given	1.90	0.64	--	-0.84
Glass for USEPA #4	06/15/99	2.50	Not given	2.50	0.92	--	1.14
Count				4.00	4.00	--	
Total				8.60	3.03	--	
Average				2.15	0.76	--	
Standard Deviation				0.30	0.14	--	

	Conc.	ln(Conc.)	VF = $\frac{C_{99}}{\text{Mean}}$
Total	8.60	3.03	
Average	2.15	0.76	
Standard Deviation	0.30	0.14	
VF		1.37	
ACF	MS=110%	0.91	
Standard	mg/L	2.68	

$w \text{ here, } C_{99} = \text{Exp}[y + 2.33 S_y]$
 $y = \text{Mean of log-transformed concentrations}$
 $S_y = \text{Standard Deviation of log-transformed concentrations}$
 $\text{ACF} = 1.0 / \text{low est acceptable \% recovery value} = 1.0 / 110\%$
 $\text{Treatment Standard} = \text{ACF} * \text{Average Concentration} * \text{VF}$
 $= 0.91 * 2.15 \text{ mg/L} * 1.37 = 2.68$



*For data that is normally distributed, 99.5 percent of the measurements will have a **Z-score** between -2.0 and 2.0. Any data point outside this range is not considered to be representative of the population from which the data points are drawn. $Z\text{-score} = (\text{Data Point Value} - \text{Average}) / \text{Standard Deviation}$.

Totals Fluoride Treatment Standard Calculations (Treated Glass, Numbers 1-4)

Total Fluoride^a - Treated

Analytical Data							
	Sample Date	Reported Sample Concentration (mg/kg)	Reported Duplicate Concentration (mg/kg)	Concentration Used (mg/kg)	ln(Conc.)	MS/MSD % Recovery	Z Score
Glass for USEPA #1	06/15/99	33.90	32.20	33.90	3.52	94.0/81.0	-1.30
Glass for USEPA #2	06/15/99	41.80	Not given	41.80	3.73	--	0.90
Glass for USEPA #3	06/15/99	40.90	Not given	40.90	3.71	--	0.67
Glass for USEPA #4	06/15/99	37.40	Not given	37.40	3.62	--	-0.27
Count				4.00	4.00	--	
Total				154.00	14.59	--	
Average				38.50	3.65	--	
Standard Deviation				3.61	0.10	--	

	Conc.	ln(Conc.)
Total	154.00	14.59
Average	38.50	3.65
Standard Deviation	3.61	0.10
VF		1.25
ACF	MS=81.0%	1.23
Standard	mg/kg	59.19

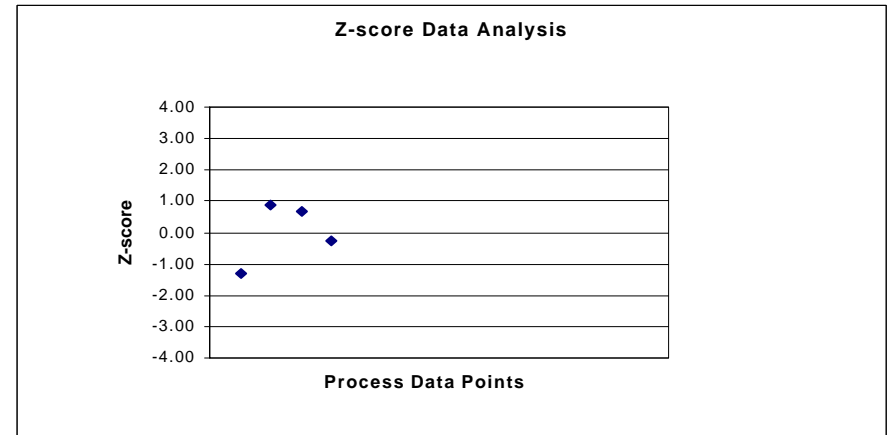
$$VF = \frac{C_{99}}{\text{Mean}}$$

$$\text{w here, } C_{99} = \text{Exp}[y + 2.33 Sy]$$

y = Mean of log-transformed concentrations
 Sy = Standard Deviation of log-transformed concentrations

$$\text{ACF} = 1.0 / \text{low est acceptable \% recovery value} = 1.0 / 81.0\%$$

$$\text{Treatment Standard} = \text{ACF} * \text{Average Concentration} * VF = 1.23 * 38.50 * 1.25 = 59.19$$



^aThe total fluoride as originally reported is considered the soluble fraction and may in some cases approximate the total recoverable when the fluoride is not tightly bound in the sample matrix. The soluble fluoride procedure was performed using a 1:1 mixture of DI water to sample and allowed to agitate for one hour. Soluble fluoride is then determined from the mixture filtrate. Conversely, the total recoverable procedure using a heated acid distillation is designed to convert tightly bound fluoride to hydrofluoric and fluosilicic acid prior to the determinative fluoride analysis.

*For data that is normally distributed, 99.5 percent of the measurements will have a **Z-score** between -2.0 and 2.0. Any data point outside this range is not considered to be representative of the population from which the data points are drawn. Z -score = (Data Point Value - Average) / Standard Deviation.

Percent Removal (%) Cyanide

Sample ID	Date	Amenable Cyanide (mg/kg)	Amenable Cyanide Duplicate	Total Cyanide (mg/kg)	Total Cyanide Duplicate
Glass for USEPA 1	6/15/99	0.5	0.5	0.5	
Glass for USEPA 2	6/15/99	0.5		0.5	
Glass for USEPA 3	6/15/99	0.5		0.5	
Glass for USEPA 4	6/15/99	0.5		0.5	0.5
Spent Pot Liner 1	6/15/99	421		714	
Spent Pot Liner 2	6/15/99	281		578	
Spent Pot Liner 3	6/15/99	303		690	
Spent Pot Liner 4	6/15/99	282	293	707	729
Average Glass		0.50		0.50	
St Dev Glass		0.00		0.00	
Average Spent		324.50		677.75	
Potliner					
St Dev Spent		64.96		68.41	
Potliner					
*Percent Removal (%)		> 99.85		> 99.93	

*Percent removal is reported as less than values since the concentrations presented here were less than the detection limit of 0.5 mg/kg.

Percent Removal (%) Fluoride

Sample ID	Date	Leachable Fluoride (mg/L)	Leachable Fluoride - Duplicate	Total Soluble Fluoride (mg/kg)	Total Soluble Fluoride Duplicate	Total Distilled Fluoride (mg/kg)	Total Distilled Fluoride - Duplicate
Glass for USEPA 1	6/15/99	1.9	1.8	33.9	3.2	66	124
Glass for USEPA 2	6/15/99	2.3		41.8		242	
Glass for USEPA 3	6/15/99	1.9		40.9		348	
Glass for USEPA 4	6/15/99	2.5		37.4		275	
Spent Pot Liner 1	6/15/99	3,210		66,400		64,100	
Spent Pot Liner 2	6/15/99	3,000	3,030	69,600		37,600	
Spent Pot Liner 3	6/15/99	3,070		57,700		33,500	
Spent Pot Liner 4	6/15/99	3,230		57,400		49,100	
	Average Glass	2.15		38.50		247	
	St Dev Glass	0.30		3.61		93	
	Average Spent Potliner	3135.00		62775.00		46075.00	
	St Dev Spent Potliner	99.83		6174.34		13711.40	
	Percent Removal (%)	> 99.93		> 99.94		> 99.46	

*Percent removal is reported as less than values since the concentrations presented here were less than the detection limit of 0.5 mg/kg.

Percent Removal (%) Arsenic

Sample ID	Date	Total Acid Soluble Arsenic (mg/kg)	Total Acid Soluble Arsenic - Duplicate	Total Arsenic (mg/kg)	Total Arsenic Duplicate	TCLP Arsenic (mg/L)	TCLP Arsenic - Duplicate
Glass for USEPA 1	6/15/99	2		2		0.01	
Glass for USEPA 2	6/15/99	2		2		0.01	
Glass for USEPA 3	6/15/99	2	2	2	2	0.01	0.01
Glass for USEPA 4	6/15/99	2		2		0.01	
Spent Pot Liner 1	6/15/99	2		4.0		0.0476	
Spent Pot Liner 2	6/15/99	2		3.1		0.0440	
Spent Pot Liner 3	6/15/99	2		3.3		0.0436	
Spent Pot Liner 4	6/15/99	2		3.5		0.0484	
	Average Glass	2.00		2.00		0.01	
	St Dev Glass	0.00		0.00		0.00	
	Average Spent	2.00		3.48		0.05	
	Potliner						
	St Dev Spent	0.00		0.39		0.002	
	Potliner						
	*Percent Removal (%)	> 0.00		> 42.45		> 78.21	

*Percent removal is reported as less than values since the concentrations presented here were less than the detection limit of 0.5 mg/kg.

Appendix F
Summary of Additional Raw Data Set

This appendix to the background document presents sampling and performance data collected in addition to samples collected at Ormet Corporation, Hannibal, Ohio on June 15, 1999. The samples presented in Appendix D of this document was used to measure concentrations in order to calculate treatment standard values for fluoride, amenable cyanide, and total cyanide. During the June 15, 1999 sampling event, EPA collected and analyzed four grab samples (i.e., a single sample of material was collected from a process stream) of untreated spent potliner and vitrified, glass residue. In a similar manner, four samples each of untreated waste and vitrified product were collected on June 22, 1999 and analyzed, as well as four samples of baghouse dust. The data measured from the samples taken on June 22, 1999 were not included in the treatment standard calculations and are presented as a supplemental data set with this appendix. Refer to Appendix D for a brief explanation of the QA/QC concerns resulting in the exclusion of this data set. Refer to section 3.3 to obtain a detailed description of the analytical methods followed to measure the sample concentrations.

TCLP Metals - Methods 1311, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/22/99	< .06	< .01	0.385	< .005	< .005	0.0218	0.0033	< .0005	0.199	< .005	< .010	4.918
Glass for USEPA 2	6/22/99	< .06	< .01	0.364	< .005	< .005	0.0206	0.0034	< .0005	0.182	0.0054	< .010	4.963
Glass for USEPA 3	6/22/99	< .06	< .01	0.580	< .005	< .005	0.0229	0.0045	< .0005	0.274	< .005	< .010	4.965
Glass for USEPA 4	6/22/99	< .06	< .01	0.364	< .005	< .005	0.0168	< .003	< .0005	0.251	< .005	0.0125	4.971
Duplicate Result		< .06	< .01	0.574	< .005	< .005	0.0234	0.0031	< .0005	0.272	0.0050	< .010	
Dup % RPD		NA	NA	1.0	NA	NA	2.2	36.8	NA	0.8	NA	NA	
MS/MSD%		93.7/93.5	97.6/97.5	83.8/82.7	91.1/91.3	97.1/98.2	93.2/93.5	92.2/92.1	96.2/99.3	86.9/88.6	92.5/91.0	98.0/98.6	
Spike % RPD		0.2	0.1	0.3	0.3	1.1	0.3	0.0	3.2	0.9	1.6	0.6	
Spent Pot Liner 1	6/22/99	< .06	0.0407	0.460	< .005	< .005	< .01	< .003	< .0005	0.0978	0.0113	< .010	10.015
Spent Pot Liner 2	6/22/99	< .06	0.0404	0.375	< .005	< .005	< .01	< .003	< .0005	0.1030	0.0111	< .010	10.041
Spent Pot Liner 3	6/22/99	< .06	0.0456	0.704	0.0057	< .005	< .01	< .003	< .0005	0.0733	0.0148	< .010	9.670
Spent Pot Liner 4	6/22/99	< .06	0.0436	0.478	< .005	< .005	0.0114	< .003	< .0005	0.0859	0.0133	< .010	10.080
Duplicate Result		< .06	0.0455	0.734	0.0059	< .005	< .01	< .003	< .0005	0.0999	0.0141	< .010	
Dup % RPD		NA	0.2	4.2	3.4	NA	NA	NA	NA	30.7	4.8	NA	
MS/MSD%		83.8/86.5	84.9/87.0	62.4/72.3	80.4/80.9	86.3/85.6	87.7/88.0	83.8/83.1	99.4/101.0	100.4/101.5	74.7/77.0	89.6/90.9	
Spike % RPD		3.2	2.0	2.9	0.6	0.9	0.4	0.7	1.4	0.9	2.8	1.4	
Baghouse 1	6/22/99	0.39	1.350	0.601	0.130	0.0194	3.400	0.0223	< .0005	4.030	0.1070	0.0352	5.798
Baghouse 2	6/22/99	0.326	1.130	0.716	0.127	0.0183	3.560	0.0180	< .0005	3.760	0.0802	0.0130	5.890
Baghouse 3	6/22/99	0.366	1.260	1.070	0.145	0.0211	2.890	0.0192	< .0005	3.980	0.0888	0.0151	5.862
Baghouse 4	6/22/99	0.369	1.290	2.800	0.138	0.0216	2.930	0.0125	< .0005	4.100	0.0923	0.0122	5.875
Duplicate Result		0.379	1.350	2.530	0.148	0.0227	2.930	0.0163	< .0005	4.200	0.0963	0.0115	
Dup % RPD		2.7	4.4	10.1	7.1	5.0	0.0	26.4	NA	2.4	4.3	5.9	
MS/MSD%		71.7/74.4	63.1/62.3	398.7/479.1	62.1/53.3	77.0/70.9	-142.8/-173.4	70.1/69.6	96.1/98.4	-235.0/-301.7	67.9/70.6	92.6/96.9	
Spike % RPD		1.2	0.1	5.2	2.6	5.2	3.0	0.7	2.4	4.9	2.5	4.0	

SW-846 Method 1311 was followed for TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The resulting leachate was analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Modified w/EDTA TCLP Metals - Methods 1311, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/22/99	< .06	0.0111	< .200	< .005	< .005	0.0494	0.0074	< .002	0.228	0.0612	< .01	5.378
Glass for USEPA 2	6/22/99	< .06	0.0119	0.311	< .005	< .005	0.0649	0.0093	< .002	0.298	0.0555	< .01	5.327
Glass for USEPA 3	6/22/99	< .06	0.0104	0.249	< .005	< .005	0.0570	0.0092	< .002	0.311	0.0595	< .01	5.280
Glass for USEPA 4	6/22/99	< .06	0.0104	0.295	< .005	< .005	0.0502	0.0091	< .002	0.257	0.0661	< .01	5.265
Duplicate Result		< .06	0.0128	0.259	< .005	< .005	0.0574	0.0088	< .002	0.318	0.0598	< .01	
Dup % RPD		NA	20.7	3.9	NA	NA	0.8	4.4	NA	2.4	0.5	NA	
MS/MSD%		86.8/86.6	97.2/95.6	91.2/89.9	82.8/83.5	84.2/83.6	79.7/78.8	76.0/76.0	104.0/105.0	80.4/80.3	105.7/104.3	91.3/101.8	
Spike % RPD		0.2	1.5	0.7	0.8	0.8	0.9	0.1	1.6	0.0	1.1	10.9	
Spent Pot Liner 1	6/22/99	< .06	0.0752	3.610	< .005	< .005	0.101	0.140	< .002	0.193	0.0609	< .01	8.707
Spent Pot Liner 2	6/22/99	< .06	0.0720	3.340	< .005	< .005	0.0912	0.116	< .002	0.163	0.0622	< .01	8.660
Spent Pot Liner 3	6/22/99	< .06	0.0811	3.660	< .005	< .005	0.113	0.167	< .002	0.200	0.0585	< .01	8.555
Spent Pot Liner 4	6/22/99	< .06	0.0774	3.650	< .005	< .005	0.111	0.158	< .002	0.198	0.0598	< .01	8.586
Duplicate Result		< .06	0.0800	3.700	< .005	< .005	0.112	0.166	< .002	0.201	0.0625	< .01	
Dup % RPD		NA	1.4	1.0	NA	NA	0.3	0.4	NA	0.4	6.6	NA	
MS/MSD%		87.9/89.4	95.3/97.0	-8.5/8.2	79.9/80.8	79.8/81.4	77.1/78.3	71.2/74.5	104.0/105.0	70.4/73.6	96.5/80.8	94.6/96.9	
Spike % RPD		1.7	1.4	1.1	1.2	1.9	1.0	2.3	1.0	2.1	14.1	2.4	
Baghouse 1	6/22/99	0.343	1.220	0.276	0.118	0.0237	5.960	5.750	< .002	3.240	0.116	< .01	6.276
Baghouse 2	6/22/99	0.374	1.240	0.326	0.123	0.0237	6.070	6.020	< .002	3.570	0.104	< .01	6.279
Baghouse 3	6/22/99	0.300	1.130	< .200	0.113	0.0219	5.770	5.500	< .002	3.050	0.129	< .01	6.245
Baghouse 4	6/22/99	0.359	1.360	0.344	0.126	0.0250	6.710	6.570	< .002	3.650	0.167	< .01	6.253
Duplicate Result		0.339	1.210	0.280	0.132	0.0251	6.350	6.170	< .002	3.460	0.111	< .01	
Dup % RPD		5.7	11.5	20.5	4.9	0.6	5.5	6.3	NA	5.3	40.2	NA	
MS/MSD%		41.8/34.7	-39.4/-47.2	31.5/30.0	46.6/30.6	54.2/48.7	-744.3/-832.0	-744.6/-882.6	103.0/103.0	-345.2/-411.1	50.5/55.8	81.6/79.3	
Spike % RPD		3.9	1.6	0.9	5.5	5.5	4.6	7.6	0.2	6.1	4.5	2.9	

A modification of SW-846 Method 1311 was followed for Modified TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. In place of the acetate buffer, a 0.1 M EDTA solution at pH 5 was used as the leaching fluid. The resulting leachate was analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Waste Extraction Test Metals - Methods CA STLC, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/22/99	< .06	0.0309	0.490	< .01	< .025	0.228	< .015	< .002	1.200	0.0495	< .01	5.360
Glass for USEPA 2	6/22/99	< .06	0.0342	0.455	< .01	< .025	0.340	0.0172	< .002	0.858	0.0442	< .01	5.342
Glass for USEPA 3	6/22/99	< .06	0.0428	0.458	< .01	< .025	0.270	0.0155	< .002	1.390	0.0540	< .01	5.361
Glass for USEPA 4	6/22/99	< .06	0.0389	0.407	< .01	< .025	0.217	< .015	< .002	0.739	0.0519	< .01	5.342
Duplicate Result		< .06	0.0543	0.450	< .01	< .025	0.271	0.0185	< .002	1.380	0.0488	< .01	
Dup % RPD		NA	23.8	1.7	NA	NA	0.6	17.4	NA	0.2	10.1	NA	
MS/MSD%		100.5/100.6	108.8/104.8	92.9/87.8	95.2/94.4	92.0/95.5	92.8/96.7	93.7/95.0	105.0/95.6	77.4/58.9	105.4/102.0	93.2/94.3	
Spike % RPD		0.2	3.2	1.9	0.9	3.2	1.9	1.2	9.3	3.0	2.7	1.2	
Spent Pot Liner 1	6/22/99	< .06	0.124	0.788	< .01	< .025	0.144	< .015	< .002	0.121	0.0713	< .01	10.404
Spent Pot Liner 2	6/22/99	< .06	0.110	0.743	< .01	< .025	0.149	< .015	< .002	0.118	0.0788	< .01	10.452
Spent Pot Liner 3	6/22/99	< .06	0.135	0.788	< .01	< .025	0.169	< .015	< .002	0.124	0.0700	< .01	10.349
Spent Pot Liner 4	6/22/99	< .06	0.124	0.744	< .01	< .025	0.164	< .015	< .002	0.130	0.0655	< .01	10.433
Duplicate Result		< .06	0.138	0.794	< .01	< .025	0.174	< .015	< .002	0.133	0.0780	< .01	
Dup % RPD		NA	2.3	0.6	NA	NA	2.7	NA	NA	6.7	10.8	NA	
MS/MSD%		97.8/99.8	101.5/106.9	86.5/43.1	83.3/82.2	89.6/91.2	87.2/88.5	90.4/89.3	98.2/99.1	76.0/79.2	101.0/104.6	93.1/95.7	
Spike % RPD		1.9	3.4	11.4	1.3	1.7	0.8	1.1	0.9	2.5	2.7	2.8	
Baghouse 1	6/22/99	0.768	2.800	1.100	0.217	0.0531	7.830	0.480	< .002	6.290	0.308	< .01	6.141
Baghouse 2	6/22/99	0.830	2.820	1.220	0.230	0.0522	7.330	0.516	< .002	6.440	0.297	< .01	6.102
Baghouse 3	6/22/99	0.815	2.800	0.988	0.217	0.0527	4.970	0.521	< .002	6.360	0.283	< .01	6.169
Baghouse 4	6/22/99	0.789	2.820	0.779	0.231	0.0528	3.690	0.565	< .002	6.640	0.307	< .01	6.131
Duplicate Result		0.784	2.800	0.743	0.230	0.0528	1.500	0.534	< .002	6.640	0.307	< .01	
Dup % RPD		0.6	0.7	4.7	0.6	0.0	84.4	5.7	NA	0.0	0.1	NA	
MS/MSD%		77.1/90.2	56.7/89.0	138.0/44.9	41.3/67.2	79.4/85.3	1,771/1,152	53.3/58.1	87.7/84.3	11.0/67.2	91.4/100	89.3/92.1	
Spike % RPD		3.3	2.7	23.2	5.0	3.2	21	1.7	4.0	2.1	3.9	2.9	

The California Wet Extraction Test was performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The resulting leachate was analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Modified Waste Extraction Test Metals - Methods CA STLC-M, 6010B mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Final Extract pH
Glass for USEPA 1	6/22/99	< .06	< .025	0.353	< .01	< .025	0.0840	< .015	< .002	0.358	0.0613	< .01	5.457
Glass for USEPA 2	6/22/99	< .06	0.0298	< .200	< .01	< .025	0.0785	< .015	< .002	0.324	0.0648	< .01	5.232
Glass for USEPA 3	6/22/99	< .06	< .025	< .200	< .01	< .025	0.0873	< .015	< .002	0.333	0.0578	< .01	5.350
Glass for USEPA 4	6/22/99	< .06	< .025	0.345	< .01	< .025	0.0860	< .015	< .002	0.345	0.0663	< .01	5.180
Duplicate Result		< .06	< .025	< .200	< .01	< .025	0.0871	< .015	< .002	0.336	0.0657	< .01	
Dup % RPD		NA	NA	NA	NA	NA	0.3	NA	NA	1.0	12.8	NA	
MS/MSD%		97.3/92.9	102.5/99.9	93.7/90.2	96.4/93.5	98.5/95.9	96.9/93.2	99.4/93.3	101.0/94.7	100.7/94.9	108.4/104.3	95.8/94.3	
Spike % RPD		4.6	2.3	3.4	3.0	2.6	2.8	6.1	6.6	2.5	3.2	1.6	
Spent Pot Liner 1	6/22/99	< .06	0.0792	2.070	0.0134	< .025	0.177	< .015	< .002	0.217	0.0600	< .01	8.060
Spent Pot Liner 2	6/22/99	< .06	0.0848	1.950	0.0121	< .025	0.173	< .015	< .002	0.207	0.0701	< .01	8.222
Spent Pot Liner 3	6/22/99	< .06	0.0914	1.840	0.0123	< .025	0.202	< .015	< .002	0.223	0.0821	< .01	8.264
Spent Pot Liner 4	6/22/99	< .06	0.0804	2.480	0.0122	< .025	0.186	< .015	< .002	0.203	0.0720	< .01	8.371
Duplicate Result		< .06	0.0895	1.870	0.0126	< .025	0.203	< .015	< .002	0.229	0.0682	< .01	
Dup % RPD		NA	2.0	1.4	2.5	NA	0.6	NA	NA	2.7	18.5	NA	
MS/MSD%		98.1/96.2	101.5/100.2	85.2/71.4	88.3/88.0	91.2/91.5	89.1/90.9	92.1/96.0	97.5/95.9	86.7/88.4	95.2/94.5	92.2/94.2	
Spike % RPD		2.0	1.0	1.7	0.2	0.3	1.1	4.0	1.6	1.0	0.6	2.1	
Baghouse 1	6/22/99	0.399	1.470	2.730	0.165	0.0276	5.780	0.764	< .002	3.670	0.181	< .01	5.931
Baghouse 2	6/22/99	0.406	1.460	0.486	0.167	0.0281	5.390	0.767	< .002	3.640	0.180	< .01	5.899
Baghouse 3	6/22/99	0.412	1.490	0.303	0.167	0.0849	6.460	0.993	< .002	3.740	0.185	0.0117	5.948
Baghouse 4	6/22/99	0.420	1.510	2.000	0.156	0.0287	6.080	0.675	< .002	3.820	0.179	< .01	5.908
Duplicate Result		0.453	1.570	2.040	0.162	0.0298	6.500	0.690	< .002	3.960	0.190	< .01	
Dup % RPD		7.4	3.7	2.0	3.9	3.8	6.7	2.2	NA	3.5	6.2	NA	
MS/MSD%		111.2/91.7	105.1/92.6	181.5/-14.5	85.5/89.7	87.2/86.3	201.1/194.0	100.6/72.2	97.9/102.0	96.0/88.7			
Spike % RPD		7.3	1.8	22.1	1.1	0.6	0.3	8.0	3.8	0.4	1.1	1.9	

A modified California Wet Extraction Test was also performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The modification included a 20:1 liquid to solid ratio with an 18 hour leaching period. The resulting leachate was for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

Total PAHs - Method 8270B mg/kg

Sample ID	Sample Collection Date	Acenaphthene	Anthracene	Benz (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (g,h,i) perylene	Benzo (k) fluoranthene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Indeno (1,2,3-cd) pyrene	Phenanthrene	Pyrene
Glass for USEPA 1	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Glass for USEPA 2	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Glass for USEPA 3	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Glass for USEPA 4	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
MS/MSD%		104.0/102.0	98.7/101.0	98.9/100.0	93.6/94.7	97.7/97.6	77.3/79.9	95.2/102.0	99.1/100.0	81.9/83.9	101/102	76.9/79.0	103.0/102.0	103.0/104.0
Spike % RPD		1.8	1.9	1.6	1.1	0.1	3.3	6.8	1.2	2.5	1.2	2.7	0.1	1.1
Spent Pot Liner 1	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Spent Pot Liner 2	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Spent Pot Liner 3	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Spent Pot Liner 4	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
MS/MSD%		72.3/87.3	29.1/53.4	5.9/18.1	1.4/4.7	2.7/8.2	0.3/1.1	1.5/5.0	6.7/19.1	0.1/0.7	29.7/55.3	0.2/0.9	43.8/66.2	26.5/54.6
Spike % RPD		18.8	59.0	101.8	106.1	100.8	116.7	107.0	96.1	172.6	60.3	129.1	40.8	69.4
Baghouse 1	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Baghouse 2	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Baghouse 3	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
Baghouse 4	6/22/99	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330	< .330
MS/MSD%		63.3/61.4	63.6/60.5	62.9/61.6	62.3/60.0	64.8/62.4	62.2/59.3	66.2/61.5	64.1/61.7	62.5/60.2	64.7/63.0	60.2/59.5	64.1/62.0	64.6/63.0
Spike % RPD		3.1	5.0	2.1	3.8	3.8	4.7	7.3	3.8	3.8	2.5	1.1	3.2	2.4

PAHs were analyzed using SW-846 Method 8270B. PAH compounds include: acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

General Chemistry - mg/kg

Sample ID	Sample Collection Date	Moisture (%)	Total Cyanide	Ammenable Cyanide	pH	Total Acid Soluble Arsenic	Total Arsenic
Glass for USEPA 1	6/22/99	2.1	1.1	< 0.5	9.34	< 2	< 2
Glass for USEPA 2	6/22/99	3.2	0.9	< 0.5	9.35	< 2	< 2
Glass for USEPA 3	6/22/99	3.1	1.2	< 0.5	9.16	< 2	< 2
Glass for USEPA 4	6/22/99	3.1	0.9	< 0.5	8.65	< 2	< 2
Duplicate Result			1.1	< 0.5	8.66	< 2	< 2
Dup % RPD			0.0	NA	0.1	NA	NA
MS/MSD%			109.3/110.9	0.0/0.0		81.6/86.3	78.4/66.0
Spike % RPD			6.7	NA		5.5	17.1
Spent Pot Liner 1	6/22/99	< 2	884	503	12.78	< 2	2.9
Spent Pot Liner 2	6/22/99	< 2	968	416	12.75	< 2	3.0
Spent Pot Liner 3	6/22/99	< 2	814	565	12.77	< 2	2.9
Spent Pot Liner 4	6/22/99	< 2	889	479	12.86	< 2	3.1
Duplicate Result						< 2	3.0
Dup % RPD						NA	3.3
MS/MSD%						-8.3/15.4	99.4/96.0
Spike % RPD						666	2.5
Baghouse 1	6/22/99	< 2	< 0.5	< 0.5	7.59	35.9	37.4
Baghouse 2	6/22/99	< 2	< 0.5	< 0.5	7.59	33.5	36.7
Baghouse 3	6/22/99	< 2	< 0.5	< 0.5	7.59	38.0	36.8
Baghouse 4	6/22/99	< 2	< 0.5	< 0.5	7.58	36.5	34.6
Duplicate Result			< 0.5	< 0.5	7.59	35.5	36.3
Dup % RPD			NA	NA	0.0	2.6	4.7
MS/MSD%			102.2/100	0.0/0.0		108/88.5	63.9/71.7
Spike % RPD			4.3	NA		3.6	1.6

Total and amenable cyanide values were measured using SW-846 9010B.

Arsenic analyses using the traditional acid digestion (HN03) procedures will be identified as "total acid soluble arsenic". In order to more closely correlate these results to the total arsenic data, the microwave assisted technique (3051) will be employed.

Total arsenic will be determined using a microwave assisted digestion technique (3052) in which hydrofluoric acid is used to completely digest highly siliceous sample materials. Given the safety hazards and the instrumentation limitations with using this acid, if it can be demonstrated that the sample matrices are low in silica content, the laboratory will have the option of using the perchloric acid digestion technique according to Method 3052. However, the silica content of the treated waste is known to range from 10 - 40%, and in this case the laboratory should consider using boric acid to neutralize potential high fluoride digestate concentrations in order to protect quartz instrumentation parts.

Fluoride

Sample ID	Sample Collection Date	Leachable Fluoride (mg/L)	Moisture (%)	Leachable Fluoride (Initial pH)	Leachable Fluoride (Final pH)	Leachable Fluoride pH 11-5-12.5 (mg/L)	Leachable Fluoride pH 11-5-12.5 (Init pH)	Leachable Fluoride pH 11-5-12.5 (Final pH)	pH	Total Fluoride (mg/kg)	Total Fluoride Distilled (mg/kg)
Glass for USEPA 1	6/22/99	803	2.1	9.3	9.464	32.0	12.0	12.240	9.34	2,310	1,920
Glass for USEPA 2	6/22/99	71.4	3.2	9.3	9.421	28.4	12.0	12.204	9.35	60.6	661
Glass for USEPA 3	6/22/99	11.0	3.1	9.2	9.404	2.8	12.0	12.233	9.16	37.3	512
Glass for USEPA 4	6/22/99	18.3	3.1	8.6	9.391	4.1	12.0	12.251	8.65	42.7	699
Duplicate Result		17.9							8.66	43.4	
Dup % RPD		2.2							0.1	1.6	
MS/MSD%		106/109								102.5/95	
Spike % RPD		1.0								2.4	
Spent Pot Liner 1	6/22/99	3,180	< 2			3,951			12.78	147,000	
Spent Pot Liner 2	6/22/99	3,430	< 2			3,940			12.75	219,000	
Spent Pot Liner 3	6/22/99	3,260	< 2			3,670			12.77	96,600	
Spent Pot Liner 4	6/22/99	3,300	< 2			3,680			12.86	67,100	
Baghouse 1	6/22/99	17,800	< 2			16,800			7.59	152,000	
Baghouse 2	6/22/99	33,600	< 2			15,100			7.59	163,000	
Baghouse 3	6/22/99	16,400	< 2			15,400			7.59	277,000	
Baghouse 4	6/22/99	16,100	< 2			13,300			7.58	191,000	
Duplicate Result		17,400							7.59	328,000	
Dup % RPD		2.3							0.0	16.9	
MS/MSD%		105/105								110/105	
Spike % RPD		0.0								1.1	

The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste was determined using ASTM D3987. This procedure utilized reagent water as the leaching media. The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste was determined using a modification of ASTM D3987 in which the leaching fluid is prepared using a NaOH solution at pH 11.5 to 12.5.

Appendix G

Summary of Ormet Data Submitted to EPA Region V

This appendix to the background document presents sampling and performance data gathered in addition to the supporting data used to calculate treatment standard values for fluoride, amenable cyanide, and total cyanide. The analytical data used to determine the treatment standards were gathered from samples taken at the Ormet Corporation treatment facility in Hannibal, Ohio in June 1999. During the June 15, 1999 sampling event, EPA collected four grab samples (i.e., a single sample of material was collected from a process stream) of untreated spent potliner and vitrified, glass residue. Additional samples were also collected for EPA Region V to provide supporting data for a delisting petition by Ormet Corporation and are presented in this appendix. These ten composite samples (i.e., a single sample of material was collected from a pile in a tray of a larger, homogenous sample) also were collected from untreated spent potliner and vitrified, glass residue. In a similar manner, five samples each of untreated waste and vitrified product were collected on June 22, 1999, as well as samples of baghouse dust. Presented on the following pages are laboratory data of the ten total samples of vitrified, glass residue only collected on June 15 and June 22, 1999.

Total Metals - mg/kg

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cyanide	Fluoride	Lead	Mercury	Nickel	pH (S.U.)	Selenium	Silver	Sulfide	Thallium	Vanadium	Zinc
Glass Comp 1	6/15/99	<1.0	<1.0	3.5	0.14	<0.10	3.4	<0.50	180	<5.0	<0.25	15	8.38	<0.20	<2.0	<50	<0.25	2.3	1.0
Glass Comp 2	6/15/99	<1.0	<1.0	14	0.58	<0.10	11	<0.50	410	<5.0	<0.25	22	8.13	<0.20	<2.0	<50	<0.25	7.1	1.0
Glass Comp 3	6/15/99	<1.0	<1.0	12	0.5	<0.10	8.2	<0.50	570	<5.0	<0.25	14	8.23	<0.20	<2.0	<50	<0.25	5.1	<1.0
Glass Comp 4	6/15/99	<1.0	<1.0	22	0.91	<0.10	10	<0.50	490	<5.0	<0.25	21	7.83	<0.20	<2.0	<50	<0.25	6.7	<1.0
Glass Comp 1	6/22/99	<1.0	1.4	67	2.7	<0.10	22	0.88	2,200	<5.0	<0.25	23	9.26	0.73	<2.0	450	<0.25	18	<1.0
Glass Comp 2	6/22/99	<1.0	1.8	40	1.6	<0.10	17	0.69	3,400	<5.0	<0.25	36	9.15	<0.40	<2.0	<50.0	<0.25	11	<1.0
Glass Comp 3	6/22/99	<1.0	1.2	34	1.4	<0.10	14	0.91	1,500	<5.0	<0.25	34	9.24	<0.40	<2.0	67	<0.25	12	<1.0
Glass Comp 4	6/22/99	<1.0	1.7	61	2.5	<0.10	21	1.1	2,900	<5.0	<0.25	31	9.24	<0.40	<2.0	98	<0.25	18	<1.0

Samples reported were measured with analysis Methods SW-846 6010B\3050B, unless otherwise specified.

Cyanide, Total measured with analysis SW-846 9010B\9014.

Fluoride measured with analysis SM4500-F-B

Sulfide measured with analysis 376.1\9030.

Mercury measured with analysis SW-846 7471A\7471A.

Antimony measured with analysis SW-846 7041.

Selenium measured with anlaysis SW-846 7740.

Thallium measured with analysis SW-846 7841.

All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

Semivolatile Organics - mg/kg

Compounds	CAS No.	Glass Comp. #1 (6/15/99)	Glass Comp. #2 (6/15/99)	Glass Comp. #3 (6/15/99)	Glass Comp. #4 (6/15/99)	Glass Comp. #1 (6/22/99)	Glass Comp. #2 (6/22/99)	Glass Comp. #3 (6/22/99)	Glass Comp. #4 (6/22/99)
Acenaphthene	83-32-9	--	<.17	--	--	<.17	<.17	<.17	<.17
Acenaphthylene	208-96-8	--	<.17	--	--	<.17	<.17	<.17	<.17
Anthracene	120-12-7	--	<.17	--	--	<.17	<.17	<.17	<.17
Benzoic acid	65-85-0	--	<.83	--	--	<.83	<.83	<.83	<.83
Benz(a)anthracene	56-55-3	--	<.17	--	--	<.17	<.17	<.17	<.17
Benzo(b)fluoranthene	205-99-2	--	<.17	--	--	<.17	<.17	<.17	<.17
Benzo(k)fluoranthene	207-08-9	--	<.17	--	--	<.17	<.17	<.17	<.17
Benzo(g,h,i)perylene	191-24-2	--	<.17	--	--	<.17	<.17	<.17	<.17
Benzo(a)pyrene	50-32-8	--	<.17	--	--	<.17	<.17	<.17	<.17
Benzyl alcohol	100-51-6	--	<.17	--	--	<.17	<.17	<.17	<.17
Bis(2-chloroethoxy)methane	111-91-1	--	<.17	--	--	<.17	<.17	<.17	<.17
Bis(2-chloroethyl) ether	111-44-4	--	<.17	--	--	<.17	<.17	<.17	<.17
Bis(2-chloroisopropyl) ether	108-60-1	--	<.17	--	--	<.17	<.17	<.17	<.17
Bis(2-ethylhexyl) phthalate	117-81-7	--	<.17	--	--	<.17	<.17	<.17	<.17
4-Bromophenyl phenyl ether	101-55-3	--	<.17	--	--	<.17	<.17	<.17	<.17
Butyl benzyl phthalate	85-68-7	--	<.17	--	--	<.17	<.17	<.17	<.17
4-Chloroaniline	106-47-8	--	<.17	--	--	<.17	<.17	<.17	<.17
4-Chloro-3-methylphenol	59-50-7	--	<.17	--	--	<.17	<.17	<.17	<.17
2-Chloronaphthalene	91-58-7	--	<.17	--	--	<.17	<.17	<.17	<.17
2-Chlorophenol	95-57-8	--	<.17	--	--	<.17	<.17	<.17	<.17
4-Chlorophenyl phenyl ether	7005-72-3	--	<.17	--	--	<.17	<.17	<.17	<.17
Chrysene	218-01-9	--	<.17	--	--	<.17	<.17	<.17	<.17
Dibenz(a,h)anthracene	53-70-3	--	<.17	--	--	<.17	<.17	<.17	<.17
Dibenzofuran	132-64-9	--	<.17	--	--	<.17	<.17	<.17	<.17
Di-n-butyl phthalate	84-74-2	--	<.17	--	--	<.17	<.17	<.17	<.17
1,2-Dichlorobenzene	95-50-1	--	<.17	--	--	<.17	<.17	<.17	<.17
1,3-Dichlorobenzene	541-73-1	--	<.17	--	--	<.17	<.17	<.17	<.17
1,4-Dichlorobenzene	106-46-7	--	<.17	--	--	<.17	<.17	<.17	<.17
3,3'-Dichlorobenzidine	91-94-1	--	<.33	--	--	<.33	<.33	<.33	<.33
2,4-Dichlorophenol	120-83-2	--	<.17	--	--	<.17	<.17	<.17	<.17
Diethyl phthalate	84-66-2	--	<.17	--	--	<.17	<.17	<.17	<.17
2,4-Dimethylphenol	105-67-9	--	<.17	--	--	<.17	<.17	<.17	<.17
Dimethyl phthalate	131-11-3	--	<.17	--	--	<.17	<.17	<.17	<.17
4,6-Dinitro-2-methylphenol	534-52-1	--	<.83	--	--	<.83	<.83	<.83	<.83
2,4-Dinitrophenol	51-28-5	--	<.83	--	--	<.83	<.83	<.83	<.83
2,4-Dinitrotoluene	121-14-2	--	<.17	--	--	<.17	<.17	<.17	<.17
2,6-Dinitrotoluene	606-20-2	--	<.17	--	--	<.17	<.17	<.17	<.17

Samples reported were measured with analysis Methods SW-846 8270C\3550B. All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

Semivolatile Organics (cont.) - mg/kg

Compounds	CAS No.	Glass Comp. #1 (6/15/99)	Glass Comp. #2 (6/15/99)	Glass Comp. #3 (6/15/99)	Glass Comp. #4 (6/15/99)	Glass Comp. #1 (6/22/99)	Glass Comp. #2 (6/22/99)	Glass Comp. #3 (6/22/99)	Glass Comp. #4 (6/22/99)
Di-n-octyl phthalate	117-84-0	--	<.17	--	--	<.17	<.17	<.17	<.17
Fluoranthene	206-44-0	--	<.17	--	--	<.17	<.17	<.17	<.17
Fluorene	86-73-7	--	<.17	--	--	<.17	<.17	<.17	<.17
Hexachlorobenzene	118-74-1	--	<.17	--	--	<.17	<.17	<.17	<.17
Hexachlorobutadiene	87-68-3	--	<.17	--	--	<.17	<.17	<.17	<.17
Hexachlorocyclopentadiene	77-47-4	--	<.17	--	--	<.17	<.17	<.17	<.17
Hexachloroethane	67-72-1	--	<.17	--	--	<.17	<.17	<.17	<.17
Indeno(1,2,3-cd)pyrene	193-39-5	--	<.17	--	--	<.17	<.17	<.17	<.17
Isophorone	78-59-1	--	<.17	--	--	<.17	<.17	<.17	<.17
2-Methylnaphthalene	91-57-6	--	<.17	--	--	<.17	<.17	<.17	<.17
2-Methylphenol	95-48-7	--	<.17	--	--	<.17	<.17	<.17	<.17
3-Methylphenol	108-39-4	--	<.17	--	--	<.17	<.17	<.17	<.17
4-Methylphenol	106-44-5	--	<.17	--	--	<.17	<.17	<.17	<.17
Naphthalene	91-20-3	--	<.17	--	--	<.17	<.17	<.17	<.17
2-Nitroaniline	88-74-4	--	<.83	--	--	<.83	<.83	<.83	<.83
3-Nitroaniline	99-09-2	--	<.83	--	--	<.83	<.83	<.83	<.83
4-Nitroaniline	100-01-6	--	<.83	--	--	<.83	<.83	<.83	<.83
Nitrobenzene	98-95-3	--	<.17	--	--	<.17	<.17	<.17	<.17
2-Nitrophenol	88-75-5	--	<.17	--	--	<.17	<.17	<.17	<.17
4-Nitrophenol	100-02-7	--	<.83	--	--	<.83	<.83	<.83	<.83
N-Nitrosodiphenylamine	86-30-6	--	<.17	--	--	<.17	<.17	<.17	<.17
N-Nitrosodi-n-propylamine	621-64-7	--	<.17	--	--	<.17	<.17	<.17	<.17
Pentachlorophenol	87-86-5	--	<.83	--	--	<.83	<.83	<.83	<.83
Phenanthrene	85-01-8	--	<.17	--	--	<.17	<.17	<.17	<.17
Phenol	108-95-2	--	<.17	--	--	<.17	<.17	<.17	<.17
Pyrene	129-00-0	--	<.17	--	--	<.17	<.17	<.17	<.17
1,2,4-Trichlorobenzene	120-82-1	--	<.17	--	--	<.17	<.17	<.17	<.17
2,4,5-Trichlorophenol	95-95-4	--	<.83	--	--	<.83	<.83	<.83	<.83
2,4,6-Trichlorophenol	88-06-2	--	<.17	--	--	<.17	<.17	<.17	<.17

Samples reported were measured with analysis Methods SW-846 8270C\3550B. All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

TCLP Semivolatile Organics - mg/kg

Compounds	CAS No.	Glass Comp. #1 (6/15/99)	Glass Comp. #2 (6/15/99)	Glass Comp. #3 (6/15/99)	Glass Comp. #4 (6/15/99)	Glass Comp. #1 (6/22/99)	Glass Comp. #2 (6/22/99)	Glass Comp. #3 (6/22/99)	Glass Comp. #4 (6/22/99)
o-Cresol	95-48-7	--	<.05	--	--	<.05	<.05	<.05	<.05
m-Cresol	108-39-4	--	<.05	--	--	<.05	<.05	<.05	<.05
p-Cresol	106-44-5	--	<.05	--	--	<.05	<.05	<.05	<.05
1,4-Dichlorobenzene	106-46-7	--	<.05	--	--	<.05	<.05	<.05	<.05
2,4-Dichlorotoluene	121-14-2	--	<.05	--	--	<.05	<.05	<.05	<.05
Hexachlorobenzene	118-74-1	--	<.05	--	--	<.05	<.05	<.05	<.05
Hexachlorobutadiene	87-68-3	--	<.05	--	--	<.05	<.05	<.05	<.05
Hexachloroethane	67-72-1	--	<.05	--	--	<.05	<.05	<.05	<.05
Nitrobenzene	98-95-3	--	<.05	--	--	<.05	<.05	<.05	<.05
Pentachlorophenol	87-86-5	--	<.25	--	--	<.25	<.25	<.25	<.25
Pyridine	110-86-1	--	<.05	--	--	<.05	<.05	<.05	<.05
2,4,5-Trichlorophenol	95-95-4	--	<.25	--	--	<.25	<.25	<.25	<.25
2,4,6,-Trichlorophenol	88-06-2	--	<0.5	--	--	<0.5	<0.5	<0.5	<0.5

Samples reported were measured with analysis Methods SW-846 8270C\3510C\1311. All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

TCLP Volatile Organics - mg/kg

Compounds	CAS No.	Glass Grab #1 (6/15/99)	Glass Grab #2 (6/15/99)	Glass Grab #3 (6/15/99)	Glass Grab #4 (6/15/99)	Glass Grab #1 (6/22/99)	Glass Grab #2 (6/22/99)	Glass Grab #3 (6/22/99)	Glass Grab #4 (6/22/99)
Benzene	71-43-2	<.05	--	--	--	<.05	--	--	--
Carbon tetrachloride	56-23-5	<.05	--	--	--	<.05	--	--	--
Chlorobenzene	108-90-7	<.05	--	--	--	<.05	--	--	--
Chloroform	67-66-3	<.05	--	--	--	<.05	--	--	--
1,2-Dichloroethane	107-06-2	<.05	--	--	--	<.05	--	--	--
1,1-Dichloroethene	75-35-4	<.05	--	--	--	<.05	--	--	--
Methyl ethyl ketone	78-93-3	<1	--	--	--	<1	--	--	--
Tetrachloroethene	127-18-4	<.05	--	--	--	<.05	--	--	--
Trichloroethene	79-01-6	<.05	--	--	--	<.05	--	--	--
Vinyl Chloride	75-01-4	<.1	--	--	--	<.1	--	--	--

Samples reported were measured with analysis Methods SW-846 8260B\1311. All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

Volatile Organics - mg/kg

Compounds	CAS No.	Glass Grab #1 (6/15/99)	Glass Grab #2 (6/15/99)	Glass Grab #3 (6/15/99)	Glass Grab #4 (6/15/99)	Glass Grab #1 (6/22/99)	Glass Grab #2 (6/22/99)	Glass Grab #3 (6/22/99)	Glass Grab #4 (6/22/99)
Acetone	67-64-1	<.1	--	--	--	<.1	--	--	--
Benzene	71-43-2	<.005	--	--	--	<.005	--	--	--
Bromobenzene	108-86-1	<.005	--	--	--	<.005	--	--	--
Bromochloromethane	74-97-5	<.005	--	--	--	<.005	--	--	--
Bromodichloromethane	75-27-4	<.005	--	--	--	<.005	--	--	--
Bromoform	75-25-2	<.005	--	--	--	<.005	--	--	--
Bromomethane	74-83-9	<.01	--	--	--	<.01	--	--	--
2-Butanone (MEK)	78-93-3	<.1	--	--	--	<.1	--	--	--
n-Butylbenzene	104-51-8	<.005	--	--	--	<.005	--	--	--
sec-Butylbenzene	135-98-8	<.005	--	--	--	<.005	--	--	--
tert-Butylbenzene	98-06-6	<.005	--	--	--	<.005	--	--	--
Carbon disulfide	75-15-0	<.005	--	--	--	<.005	--	--	--
Carbon tetrachloride	56-23-5	<.005	--	--	--	<.005	--	--	--
Chlorobenzene	108-90-7	<.005	--	--	--	<.005	--	--	--
Chlorodibromomethane	124-48-1	<.005	--	--	--	<.005	--	--	--
Chloroethane	75-00-3	<.01	--	--	--	<.01	--	--	--
2-Chloroethyl vinyl ether	110-75-8	<.01	--	--	--	<.01	--	--	--
Chloroform	67-66-3	<.005	--	--	--	<.005	--	--	--
Chloromethane	74-87-3	<.01	--	--	--	<.01	--	--	--
2-Chlorotoluene	95-49-8	<.005	--	--	--	<.005	--	--	--
4-Chlorotoluene	106-43-4	<.005	--	--	--	<.005	--	--	--
1,2-Dibromo-3-chloropropane	96-12-8	<.005	--	--	--	<.005	--	--	--
1,2-Dibromoethane	106-93-4	<.005	--	--	--	<.005	--	--	--
Dibromomethane	74-95-3	<.005	--	--	--	<.005	--	--	--
1,2-Dichlorobenzene	95-50-1	<.005	--	--	--	<.005	--	--	--
1,3-Dichlorobenzene	541-73-1	<.005	--	--	--	<.005	--	--	--
1,4-Dichlorobenzene	106-46-7	<.005	--	--	--	<.005	--	--	--
Dichlorodifluoromethane	75-71-8	<.01	--	--	--	<.01	--	--	--
1,1-Dichloroethane	75-34-3	<.005	--	--	--	<.005	--	--	--
1,2-Dichloroethane	107-06-2	<.005	--	--	--	<.005	--	--	--
1,1-Dichloroethene	75-35-4	<.005	--	--	--	<.005	--	--	--
cis-1,2-Dichloroethene	156-59-2	<.005	--	--	--	<.005	--	--	--
trans-1,2-Dichloroethene	156-60-5	<.005	--	--	--	<.005	--	--	--
1,2-Dichloropropane	78-87-5	<.005	--	--	--	<.005	--	--	--
1,3-Dichloropropane	142-28-9	<.005	--	--	--	<.005	--	--	--
2,2-Dichloropropane	594-20-7	<.005	--	--	--	<.005	--	--	--
cis-1,3-Dichloropropene	10061-01-5	<.005	--	--	--	<.005	--	--	--
trans-1,3-Dichloropropene	10061-02-6	<.005	--	--	--	<.005	--	--	--
1,1-Dichloropropene	563-58-6	<.005	--	--	--	<.005	--	--	--

Samples reported were measured with analysis Methods SW-846 8260B. All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

Volatile Organics (cont.) - mg/kg

Compounds	CAS No.	Glass Grab #1 (6/15/99)	Glass Grab #2 (6/15/99)	Glass Grab #3 (6/15/99)	Glass Grab #4 (6/15/99)	Glass Grab #1 (6/22/99)	Glass Grab #2 (6/22/99)	Glass Grab #3 (6/22/99)	Glass Grab #4 (6/22/99)
Ethylbenzene	100-41-4	<.005	--	--	--	<.005	--	--	--
Hexachlorobutadiene	87-68-3	<.005	--	--	--	<.005	--	--	--
2-Hexanone	591-78-6	<.01	--	--	--	<.01	--	--	--
Isopropylbenzene	98-82-8	<.005	--	--	--	<.005	--	--	--
p-Isopropyltoluene	99-87-6	<.005	--	--	--	<.005	--	--	--
Methylene chloride	75-09-2	<.005	--	--	--	<.005	--	--	--
4-Methyl-2-pentanone (MIBK)	108-10-1	<.01	--	--	--	<.01	--	--	--
Napthalene	91-20-3	<.01	--	--	--	<.01	--	--	--
n-Propylbenzene	103-65-1	<.005	--	--	--	<.005	--	--	--
Styrene	100-42-5	<.005	--	--	--	<.005	--	--	--
1,1,1,2-Tetrachloroethane	630-20-6	<.005	--	--	--	<.005	--	--	--
1,1,2,2-Tetrachloroethane	79-34-5	<.005	--	--	--	<.005	--	--	--
Tetrachloroethene	127-18-4	<.005	--	--	--	<.005	--	--	--
Toluene	108-88-3	<.005	--	--	--	<.005	--	--	--
1,2,3-Trichlorobenzene	87-61-6	<.005	--	--	--	<.005	--	--	--
1,2,4-Trichlorobenzene	120-82-1	<.005	--	--	--	<.005	--	--	--
1,1,1-Trichloroethane	71-55-6	<.005	--	--	--	<.005	--	--	--
1,1,2-Trichloroethane	79-00-5	<.005	--	--	--	<.005	--	--	--
Trichloroethene	79-01-6	<.005	--	--	--	<.005	--	--	--
Trichlorofluoromethane	75-69-4	<.01	--	--	--	<.01	--	--	--
1,2,3-Trichloropropane	96-18-4	<.005	--	--	--	<.005	--	--	--
1,2,4-Trimethylbenzene	95-63-6	<.005	--	--	--	<.005	--	--	--
1,3,5-Trimethylbenzene	108-67-8	<.005	--	--	--	<.005	--	--	--
Vinyl acetate	108-05-4	<.01	--	--	--	<.01	--	--	--
Vinyl chloride	75-01-4	<.01	--	--	--	<.01	--	--	--
o-Xylene	95-47-6	<.005	--	--	--	<.005	--	--	--
m-Xylene	108-38-3	<.005	--	--	--	<.005	--	--	--
p-Xylene	106-42-3	<.005	--	--	--	<.005	--	--	--

Samples reported were measured with analysis Methods SW-846 8260B. All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

TCLP Metals - Acid Extraction mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium (total)	Cadmium (total)	Chromium	Fluoride (distilled)	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Glass Comp 1	6/15/99	<0.04	<0.008	0.059	<0.005	<0.005	<0.04	1.8	<0.20	<0.005	0.19	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 2	6/15/99	<0.04	<0.008	0.17	<0.005	<0.005	<0.04	2.3	<0.20	<0.005	0.22	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 3	6/15/99	<0.04	<0.008	0.14	<0.005	<0.005	<0.04	2.1	<0.20	<0.005	0.19	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 4	6/15/99	<0.04	<0.008	0.071	<0.005	<0.005	<0.04	1.9	<0.20	<0.005	0.21	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 1	6/22/99	<0.04	<0.008	0.021	<0.005	<0.005	<0.04	1.7	<0.20	<0.005	0.24	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 2	6/22/99	<0.04	<0.008	0.035	<0.005	<0.005	<0.04	3.8	<0.20	<0.005	0.27	<0.20	<0.02	<0.012	<0.02	<0.04
Glass Comp 3	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	1.8	<0.20	<0.005	0.22	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 4	6/22/99	<0.04	<0.008	0.027	<0.005	<0.005	<0.04	1.9	<0.20	<0.005	0.21	<0.20	<0.02	<0.01	0.022	<0.04

Samples reported were measured with TCLP analysis Methods SW-846 6010/7000 and extracted using an acid extraction fluid. All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

TCLP Metals - Neutral Extract mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium (total)	Cadmium (total)	Chromium	Cyanide (TCLP)	Fluoride (distilled)	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Glass Comp 1	6/15/99	<0.04	<0.008	0.8	<0.005	<0.005	<0.04	<0.01	1.5	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 2	6/15/99	<0.04	<0.008	0.045	<0.005	<0.005	<0.04	<0.01	1.3	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 3	6/15/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.8	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 4	6/15/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.8	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 1	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	2.6	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 2	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.7	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 3	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.4	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 4	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.8	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04

Samples reported were measured with TCLP analysis Methods SW-846 6010/7000 and extracted using neutral extraction fluid (distilled water). All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

TCLP Metals - Base Extract mg/L

Sample ID	Sample Collection Date	Antimony	Arsenic	Barium	Beryllium (total)	Cadmium (total)	Chromium	Cyanide (TCLP)	Fluoride (distilled)	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Glass Comp 1	6/15/99	<0.04	<0.008	<0.0004	<0.005	<0.005	<0.0016	<0.01	2.2	<0.04	<0.005	<0.0064	<0.04	<0.0004	<0.01	<0.0004	<0.0016
Glass Comp 2	6/15/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	2.4	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 3	6/15/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	2.1	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 4	6/15/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	2.3	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 1	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.4	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 2	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.3	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 3	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.5	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04
Glass Comp 4	6/22/99	<0.04	<0.008	<0.02	<0.005	<0.005	<0.04	<0.01	1.8	<0.20	<0.005	<0.08	<0.20	<0.02	<0.01	<0.02	<0.04

Samples reported were measured with TCLP analysis Methods SW-846 6010/7000 and extracted using base extraction fluid (0.1N NaOH). All results on solids/sludges are reported on a dry weight basis, where applicable, unless otherwise specified.

Appendix H
Ormet Site Visit Report

ORMET SITE VISIT – June 15, 1999

Trip Report SAMPLING

Frit: charcoal color (color varies with flow rate: lower flow rate – greener glass), subangular-angular, varied size (almost dust-small rock 2" diameter), shiny/refractory before dries- more powdery when dry

8 total samples (4 on 6/15; 4 next week)

samples collected at 2 hour intervals

composite (for Region 5 delisting) and grab (for headquarters) samples collected

composite: 4 shovel-fulls taken from front and back of pile, mixed in tray,

10 samples collected from tray

grab: 2 shovel-fulls taken from same spot in pile, dumped in tray but not mixed, 1 sample collected from tray

Potliner: sampling influent after crushed to fine powder but before combined with sand and limestone to make glass

The CMS™ Process

Potliner stored temporarily (approx. 1 month) in holding bins before vitrified – older potliner crushes better because it is dry

Initially potliner (7 tons) goes into breaker/feeder as large chunks (1ft–3ft long), comes out size of softballs

Next, SPL goes through autogenous mill which grinds it to -40 mesh (very fine dust). Mill does not use grinder, instead it rotates and drops material. Negative air flow system causes ground particle to be swept into classification system. An air heater heats the air coming into the system to ensure the ground product is dry. If particles are not correct size (gyrotor air classifier separates properly from improperly sized), they are sent back through the mill. Sampling occurs after this process.

Properly ground SPL is conveyed to a capacity storage tank by pneumatic transporter. Then conveyed to silo which feeds the batch weigh hopper where correct proportions of SPL, sand and limestone are weighed.

SPL mixed with sand and limestone in blender.

Mixture fed at continuous rate into melter system. Melter system consists of a Counter Rotating Vortex (CRV) Reactor, a Cyclone Melter, and a Separator/Reservoir. Batch material flows at a rate of 4000lbs/hr into the CRV Reactor which is refractory lined, carbon steel, water cooled vessel. Temperatures approx. 2400°F — obtained by igniting natural gas and preheated air (both have tangential motion). High inlet velocities and tangentially opposed flows provide for flame stability. No burner is used in this process. Materials begin to melt in the CRV Reactor and flow downward to the Cyclone Melter. Melting of the glass is completed here and the glass is separated from the gas. The separated gas is used to preheat the air that is entering the reactor, and then is sent to a baghouse to remove particulate matter. The molten glass is dropped into a water quench tank where it solidifies into the glass frit. The frit is conveyed into a containment building and dropped onto a concrete pad.

1 hour residence time in entire system for glass

ALUMINUM PRODUCTION

32 hour cycle; average pot ready to come out after 1400 days – at this point generate SPL

Appendix I
Sampling and Analysis Plan for
Ormet Sampling Activity – June 22, 1999

**SAMPLING AND ANALYSIS PLAN
FOR
LAND DISPOSAL RESTRICTIONS TREATMENT
STANDARD DEVELOPMENT OF K088 WASTE**

Ormet Primary Aluminum Company
Hannibal, Ohio

Prepared For:

U.S. Environmental Protection Agency
Office of Solid Waste
2800 Crystal Drive
Arlington, VA 22202

Prepared By:

Science Applications International Corporation
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Reston, VA 20190

June 22, 1999

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3. PROJECT DESCRIPTION

3.1 Problem Definition/Background

Under the authority of the Resource Conservation and Recovery Act (RCRA) of 1976, as amended, the Environmental Protection Agency is developing a rule to propose changes to the 40 CFR Part 268 Land Disposal Restriction (LDR) treatment standards applicable to K088 waste. This proposal is intended to comply with a commitment made by the Agency in the September 24, 1998 K088 interim final rule which outlined a long-term strategy to amend the current treatment standards.

3.2 Project/Task Description

The purpose of this Sampling and Analysis Plan (SAP) is to establish site-specific quality assurance and quality control (QA/QC) requirements for sample and data collection activities to support the development of Land Disposal Restrictions (LDR) Treatment Standards for K088 waste. The SAP complies with the requirements outlined in the *Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures and Methodology*, dated October 23, 1991. This document provides guidance to those individuals responsible for site-specific sampling and describes the policies and practices that will ensure the generation of reliable and defensible data.

3.2.1 Overview

The Environmental Protection Agency (EPA) is authorized to develop LDR Treatment Standards for the management of hazardous waste under Subtitle C of the Resource Conservation and Recovery Act (RCRA), as amended by the 1984 Hazardous and Solid Waste Amendments (HSWA). HSWA grants the Agency substantial flexibility in designing treatment standards to implement the program. The standards can require the use of specific treatment “methods” (technologies), or they can be stated as numerical performance standards (i.e., required concentration-based levels of treatment), as long as they “substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized” (RCRA section 3004(m)(1)). Presently, the Agency is requesting that treatment performance data be collected from the Ormet Primary Aluminum Company in Hannibal, Ohio. The collection and analysis of samples from this facility will enable the Agency to develop and propose

revised treatment standards for K088 waste.

3.2.2 General Overview of Sampling Objectives

Spent potliners from primary aluminum reduction K088 untreated and treated waste samples will be collected from the Ormet Primary Aluminum Company in Hannibal, Ohio on June 15, 1999. Constituents of concern include fluoride, metals, cyanide, PAHs, and leachable fluoride and metals. Single grab samples of untreated waste, treated waste, and baghouse dust from the treatment process will be collected at the site. A minimum of two kilograms of each waste will be collected using an appropriate pre-cleaned glass sample container.

Since the facility's contractor will perform the sample collection activities, arrangements for obtaining additional sample volume for split purposes will not be necessary.

3.3 Waste and Treatment (Ormet) Process Description - Spent Potliners from Primary Aluminum Reduction (K088)

In support of a previous delisting petition to proposed BDAT treatment standards for listed, hazardous K088 wastes, Ormet Corporation submitted to EPA untreated and treated spent potliner residue sampling data generated from primary aluminum reduction. The untreated and treated samples were taken from their vitrified treatment process based in their pilot plant. Ormet Corporation used the pilot-scale combustion melting system (CMS) vitrification process to treat their K088 wastes, and as a result, generated nonhazardous spent potliner and produced a nonleachable glass product that could be beneficially reused.

K088 is generated from the production of aluminum. The production of aluminum occurs in four distinct steps: (1) the mining of bauxite ores, (2) the refining of bauxite to produce alumina (Al_2O_3), (3) the reduction of alumina to aluminum metal, and (4) casting of the molten aluminum. Aluminum is refined by dissolving alumina (aluminum oxide) in a molten cryolite (Na_3AlF_6) bath. An electric current is then introduced, reducing the alumina to aluminum. The reduction process requires high purity aluminum oxide, carbon, electrical power, and an electrolytic cell. The reduction takes place in electrolytic hall cells or pots that consist of a steel container lined with refractory brick with an inner lining of carbon. The carbon liner is usually up to 15 inches thick and serves as the cathode in the electrolytic circuit collecting aluminum ions from the molten bath. Spent potliners from primary aluminum reduction, listed as K088,

include the carbon portion of the materials contained inside the electrolytic reduction cell and includes such wastes as fluoride, cyanide, arsenic, and many other metals, along with organic constituents (refer to Table 8–1. Constituents of Concern, included in this document).

The vitrification process used to treat the K088 wastes is an extension of an advanced multifuel capable combustion melting system (CMS) developed for high temperature process heating applications. The process involves the rapid suspension heating of waste and other additives in a preheater prior to physical and chemical melting, which then occurs within a cyclone reactor.

For feedstock preparation, spent potliner (K088) is stored temporarily to allow for some drying. The K088 is then reduced from large chunks to a fine dust of approximately 40 mesh (0.4 mm particles) to ensure complete carbon oxidation and feedstock melting in the CMS. The spent potliner is heated with cyclone exhaust air to complete drying and is then stored in a hopper. It is then mixed with various other glass-forming ingredients (sand and limestone) in a blender to improve the melting characteristics of the spent potliner and to improve the physical/chemical properties of the vitrified product of the molten, spent potliner. The exhaust air is sent to a baghouse for particulate removal.

Fuel combustion and in-flight suspension preheating of the CMS process feedstock then takes place in a high combustion intensity Counter Rotating Vortex (CRV) combustor. The feed, consisting of spent potliner and other glass forming ingredients, continuously flows into the CRV reactor, a refractory-lined vessel operating at a temperature of 2400°F using natural gas and air. The solids flow downward and begin the melting process, which is completed in the cyclone melter where the glass product is separated from the gas. The molten glass drops into a water quench tank, where the molten glass is solidified into glass frit. The frit is conveyed into a containment building and dropped onto a concrete pad. The gas is reused to preheat the air for drying the spent potliner feed.

Exhaust gas from this process is sent to a recuperator, where natural gas combustion air is preheated, and the remaining flue gas leaves and enters the recuperator plenum, which is a water cooled carbon steel vessel. The gas then enters a spray tower and passes into a baghouse where particulate is removed. This baghouse dust is then processed into an air pollution control device using alumina to dry scrub fluoride from the aluminum reduction pot exhaust gases. Any gaseous fluoride is removed and additional particulate removal proceeds. The material removed from the dry scrubber system is fluoride enriched alumina.

For purposes of the K088 sampling study described throughout this SAP, samples will be gathered in three stages. Sample grabs will be taken prior to the cyclone reactor (untreated waste), from the baghouse dust, and after forming the nonleachable glass product (treated waste).

4. PROJECT ORGANIZATION AND RESPONSIBILITIES

The responsibilities of the SAIC individuals designated as Project Manager, Work Assignment Manager, Quality Assurance Officer, Quality Assurance Manager, and Laboratory Coordinator are discussed in Sections 4.1, 4.2, 4.3, 4.4, and 4.6 respectively. The succeeding sections describe the responsibilities of the remaining technical staff and research laboratory.

4.1 Project Manager

The SAIC Project Manager will coordinate the contractor's activity and is responsible for assuring SAIC corporate management that the work is conducted in accordance with the QA requirements. His responsibilities will be the following:

- Evaluates SAIC Work Assignment Manager and staff credentials to assure that they conform to the QA requirements for training and experience
- Ensures that the program is appropriately organized with effective lines of communication; ensures that program responsibilities and authorities for making critical QA decisions are clearly understood
- Distributes and enforces the SAP among contractor and subcontractor staff
- Consults with the EPA Project Officer on proposed deviations from the SAP; approves deviations from the SAP with consent from the EPA Project Officer
- Reviews QA reports from the SAIC QA Officer and reviews and evaluates responses from the SAIC Work Assignment Manager; ensures that the actions taken are timely and appropriate
- Reports program status, problems, and corrective actions as required by the contract and the BDAT QAPP
- Reports audits conducted or directed by EPA to corporate management and the SAIC QA Officer; prepares and routes responses to the audit reports through corporate management and the SAIC QA Officer

- Reviews work products and reports to ensure that QA goals are met; approves technical reports
- Communicates with the EPA Project Officer on issues relating to the definition and conduct of the work assignment; informs the EPA Project Officer of work assignment status, and transmits all deliverables to the EPA Project Officer.

4.2 Work Assignment Manager

The SAIC Work Assignment Manager will be the contractor staff individual with overall technical oversight of the work performed under this work assignment, and will be responsible for assuring the SAIC Project Manager that the work is conducted in accordance with the QA requirements. His responsibilities will include the following:

- Evaluates staff credentials to ensure that they conform to the project QA requirements for training and experience
- Ensures that the program is appropriately organized with effective lines of communication; ensures that program responsibilities and authorities for making critical QA decisions are clearly understood
- Ensures that the SAIC QA Manager is involved in the project from the planning stage to the issuance of the final report, is fully informed, and is kept apprized of program schedules
- Informs all staff of program and project QA requirements
- Reviews and approves Standard Operating Procedures (SOPs) and Sampling and Analysis Plans (SAPs), ensuring that program QA requirements are addressed
- Ensures that the work is adequately and appropriately inspected by the SAIC Project Manager
- Reviews and approves all analytical strategies and experimental designs
- Reviews all QA reports from the SAIC QA Officer, and reviews and evaluates responses from the SAIC Project Manager; ensures that any problems detected are immediately communicated to the appropriate staff, that actions taken are timely, appropriate, and documented in the project records

- Reports project status, problems, and corrective actions as required by the contract and BDAT QAPP
- Ensures the effective and timely completion of all sampling and analysis tasks, and ensures that all project deadlines are met
- Reviews work products and reports to assure that QA goals are met; ensures that critical data are adequately verified or validated and approves technical reports. Reports work assignment status to the SAIC Project Manager
- Communicates with the EPA Project Officer when technical guidance is required for the conduct of the work assignment; documents this technical guidance to the SAIC Project Manager.

4.3 Quality Assurance Officer

The SAIC Quality Assurance Officer will be the contractor staff individual responsible for the overall QA management of the project. His responsibilities will be the following:

- Final review and evaluation of all SAP and analytical data review documents
- Review of systems, performance, and data audits for the project
- Review of any corrective actions with the SAIC Project Manager, SAIC Work Assignment Manager, and SAIC QA Manager
- Review of any proposed deviations from the BDAT QAPP or SAP with the SAIC Project Manager, SAIC Work Assignment Manager, and SAIC QA Manager
- Report reviews of all final documentation to the chief contracting officer, detailing any problems and corrective action taken.

4.4 Quality Assurance Manager

The SAIC Quality Assurance Manager is responsible for keeping the SAIC Project Manager, the SAIC Work Assignment Manager, and the SAIC QA Officer informed of the QA/QC compliance status of all project activities and of any QA/QC problems. The QA Manager's responsibilities will include the

following:

- Informs all staff of program and project QA requirements
- Reviews SOPs with the SAIC Work Assignment Manager, ensuring that program QA requirements are addressed
- Reviews all analytical strategies with the SAIC Work Assignment Manager, assuring that program QA requirements are addressed
- Conducts systems, performance, and data audits of sampling and analysis activities, assessing compliance of sample collection, analysis and handling procedures, and documentation with the BDAT QAPP
- Reports audit results along with any problems and corrective action requests to the SAIC Work Assignment Manager, SAIC Project Manager, and SAIC QA Manager
- Reviews and documents all corrective actions with the SAIC Project Manager and the SAIC Work Assignment Manager
- Reviews any proposed deviations from the BDAT QAPP with the SAIC Project Manager. Reports QA/QC program status to the SAIC Project Manager, SAIC Work Assignment Manager, and the SAIC QA Manager.

4.5 Field Team Members (Sampling Personnel)

Field team members were contracted directly by the facility, and as a result, have no organizational link to the SAIC staff. For this reason field team responsibilities have been omitted.

4.6 Laboratory Coordinator

The SAIC Laboratory Coordinator is responsible for providing the analytical laboratory with the BDAT QAPP and sampling and analysis plans (SAPs) and ensuring that the laboratory follows the protocols prescribed in those documents. The SAIC Laboratory Coordinator is responsible for the following tasks:

- Providing the laboratory with all of the information necessary to conduct the analyses using the

proper and appropriate analytical techniques; this information may include BDAT QAPP, SAPs, draft methodologies, and oral revisions to documentation

- Ensuring that the laboratory understands and has the capability and capacity to conduct the required analyses
- Ensuring that the required level of QC is adhered to for all sample analyses and that Data Quality Objectives are met
- Reviewing or supervising the review of all laboratory data reports
- Addressing laboratory QA/QC issues and recommending corrective actions
- Reporting all QC discrepancies and qualifications to the SAIC WAM
- Verifying receipt and condition of field samples submitted to the laboratory
- Assuring that the laboratory deliverables schedule meets project requirements
- Providing SAIC WAM with a final Analytical Data Report.

4.7 Technical Staff

The SAIC Technical Staff has the responsibility of performing specialized tasks under the guidance of the SAIC Work Assignment Manager. The Technical Staff is responsible for the following:

- Performing specialized tasks as requested by the SAIC Work Assignment Manager
- Providing the SAIC Work Assignment Manager with the findings of requested tasks along with a weekly status report
- Reporting any problems identified to the SAIC Quality Assurance Officer, and the SAIC Work Assignment Manager.

4.8 Analytical Laboratory

The Analytical Laboratory contracted for this project is responsible for the analysis and data reporting of all samples collected for the purposes specified in this SAP. The laboratory will work directly with the SAIC Laboratory Coordinator and will be responsible for the following:

- Provide comments on the analytical requirements as outlined in the Draft-SAP.
- Adhere to all requirements and protocols specified in the SAP. Any modifications or deviations require immediate notification to the SAIC Laboratory Coordinator for approval
- Inform the SAIC Laboratory Coordinator of any sample delivery, storage, QC or analytical problems
- Analyze all samples according to the methodology specified in the SAP
- Provide monthly status reports to the SAIC Laboratory Coordinator outlining procedures performed during the period and noting any difficulties encountered. Discuss any corrective actions that were instituted.
- Provide detailed Analytical Data Reports, to the SAIC Laboratory Coordinator, commensurate with the protocols specified in the BDAT QAPP and SAP.

5. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The overall objective for the BDAT Program's sampling and analysis efforts is to produce well-documented data of known quality that can be used to determine the best demonstrated available technologies for the various listed wastes and to develop BDAT treatment standards for these wastes. The treatment data, i.e., data resulting from treatment tests, consist of the results of analytical measurements from the analysis of the composition of the untreated wastes and the treatment residuals. The data quality for analytical measurements of the BDAT list constituents that are primarily assessed by means of the following indicators: analytical method detection limits, accuracy, precision, representativeness, comparability, and completeness.

A summary of these data quality objectives is provided in Table 5-1.

Table 5-1. Summary of Precision, Accuracy, and Completeness Data Quality Objectives

Parameter	Method	Target Method Detection Limit ¹	Precision ¹ (%RPD)	Accuracy ¹ (%R) Warning Limits	Accuracy ¹ (%R) Acceptance Limits	Completeness ¹
Total Fluoride	SM 4500-F/SW-846 Method 9056	5 mg/kg ²	< 25%	50-125%	25-150%	90%
PAHs	SW-846 Method 8270B	330 µg/kg ²	< 25%	50-125%	25-150%	90%
Total Arsenic	SW-846 Method 3052/6010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
Total Acid-Soluble Arsenic	SW-846 Method 3051/6010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
Total Cyanide	SW-846 Method 9010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
Total Amenable Cyanide	SW-846 Method 9010B	1 mg/kg ²	< 25%	50-125%	25-150%	90%
pH	SW-846 Method 9045C	NA	< 25%	NA	NA	90%
TCLP	SW-846 Method 1311	NA ³	< 25%	50-125%	NA	90%
EDTA TCLP	SW-846 Method 1311	NA ³	< 25%	50-125%	NA	90%
Leachable Fluoride	ASTM D3987	10 µg/L	<25%	50-125%	25-150%	90%
CA WET Metals	CA Waste Extraction Test	NA ³	<25%	50-125%	25-150%	90%

¹ Site-specific values will be developed from knowledge of the waste.

² Detection limits are specific to individual target analytes and the matrix sampled.

³ Arsenic measurements must achieve detection limits of 0.01 mg/L or better.

6. SAMPLING PROCEDURES

6.1 Sampling Design and Strategy

As stated in Section 4, the sample collection effort is being coordinated by the facility in conjunction with contractor staff. The facility will provide and deliver to the EPA designated laboratory eight samples each of untreated K088 waste, treated K088 waste, and baghouse dust collected from the Ormet treatment process. Specific details regarding the sample collection design and strategy performed at Ormet Primary Aluminum Company in Hannibal, Ohio will not be discussed further in this document.

6.2 Sample Preservation

It is presumed that all samples be physically preserved by storing and shipping the samples in coolers, packed in ice, at 4°C to 5°C. Specific holding times and preservation requirements are outlined in Table 6-1.

Table 6–1. Sample Containers, Preservation, and Holding Times for K088 Residuals

Sample	Parameter	Container Type and Size	Number of Sample Bottles	Preservation ¹	Holding Time ²
Untreated, Treated, Baghouse Dust	<u>Totals</u>				
	Fluoride	A		Cool ≤4 °C	28 days
	Arsenic	A		Cool ≤4 °C	180 days
	Cyanide	A		Cool ≤4 °C	14 days
	PAHs	A		Cool ≤4 °C	14 days to extraction 40 days to analysis
	pH	A		Cool ≤4 °C	7 days
	<u>Leachate</u>				
	Leachable Fluoride	A		Cool ≤4 °C	14 days to leach 28 days to analysis
	TCLP Metals	A		Cool ≤4 °C	14 days to leach 28 days to analysis
	CA Wet Metals	A		Cool ≤4 °C	14 days to leach 28 days to analysis
			Total: 8		

A 250-ml wide-mouth clear glass jar with teflon-lined cap.

1 Samples are processed for shipment and immediately cooled on ice. Upon receipt at the laboratory, all samples are immediately transferred to a refrigerator at ≤ 4 °C.

2 Holding times shall commence from the date of sample collection. Samples shall be submitted to the laboratory no later than 24 hours from the time of sample collection.

7. SAMPLE CUSTODY AND TRANSPORT

7.1 Transfer of Custody and Shipment

It is assumed that samples will be accompanied by an approved COC at all times. When the possession of samples is transferred, both the individual relinquishing the samples and the individual receiving the samples will sign, date, and note the time on the COC document. This record represents the official documentation for all transfers of the sample custody until the samples have arrived at the laboratory. The original form of the COC record will accompany each sample cooler shipment to the analytical laboratory. A copy of the COC record will be retained by the laboratory and then faxed to the sampling team, as well as the SAIC Laboratory Coordinator for inclusion to the project file.

All samples will be shipped under the exclusion allowed for transporting laboratory samples in 40 CFR 261.4(d). Samples will be packaged and labeled for shipment in compliance with current U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) dangerous goods regulations. Any additional requirements stipulated by the overnight carrier (Federal Express) will be followed.

For this sampling event all samples will be shipped from the site to the laboratory via overnight delivery.

7.2 Laboratory Sample Custody

Samples will arrive at the laboratory via overnight delivery by Federal Express. Upon receipt of the samples, the coolers will be checked for intact custody seals. The coolers will be opened and the internal cooler temperature will be recorded from either a temperature blank or thermometer shipped with each cooler. The objective is to maintain cooler temperatures to as close to 4⁰C as possible. The samples will then be unpackaged and the information on the accompanying chain-of-custody records examined. If the samples delivered match those described on the COC record, the laboratory sample custodian will sign the form and assume responsibility for the samples. If problems are noted with the sample shipment, the laboratory custodian will sign the COC form and record problems in the "Remarks" box. The laboratory will have a Standard Operating Procedure (SOP) for sample receipt, storage, and custody.

Any missing samples, missing labels, broken sample bottles, or unpreserved samples will be noted on the COC record. If there are problems with any individual samples, the sample custodian will inform the Analytical Laboratory Coordinator of such problems. The Analytical Laboratory Coordinator will then contact the SAIC Laboratory Coordinator, to determine a viable solution to the problem. In addition to the

initial contact, the Analytical Laboratory Coordinator will FAX a copy of the signed COC record with problems noted in the "Remarks" section to the SAIC Laboratory Coordinator.

All samples then will be logged into a sample receipt logbook or the computerized laboratory information system. The following information will be documented:

- Date and time of sample receipt
- Project number and name
- Field sample number
- Laboratory sample number (assigned during log-in procedure)
- Sample matrix
- Analytical parameters
- Storage location
- Log-in person's initials.

8. ANALYSIS ACTIVITIES AND SITE SPECIFIC QA/QC PROCEDURES

The collection and analysis of samples from the Ormet treatment facility will enable the Agency to develop and propose revised treatment standards for K088 waste based on the performance of a treatment technology which results in the immobilization of arsenic and fluoride, as well as other toxic metals. When applicable, the analysis of samples will follow guidelines established in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (U.S. EPA, SW-846, 3rd edition and Updates 1 through 3). If the methods outlined in Section 8 of this SAP are not appropriate for the preparation or analysis of the specific sample matrices, or are not available for a particular constituent or other parameters of interest, alternative EPA/OSW-approved methods will be selected by the EPA WAM, the SAIC WAM, and the SAIC Laboratory Coordinator.

8.1 Overview of Analysis

The analysis activities for the purpose of this sampling and analysis plan will be performed according to three main areas which are as follows:

1. Characterization of waste:

- Raw K088 waste (arsenic, fluoride, cyanide, pH, PAHs for one sample)
- Treated K088 waste (arsenic, fluoride, cyanide, pH, PAHs for one sample)
- Baghouse dust from fluoride emissions created during treatment process (arsenic, fluoride, cyanide, pH, PAHs for one sample)

2. SW-846 Leaching Methods:

- TCLP of raw, treated, and baghouse dust K088 waste (metals)
- Modified EDTA TCLP of raw, treated, and baghouse dust K088 waste (metals)

3. Alternative Leaching Methods:

- Leachable Fluoride of raw, treated, and baghouse dust K088 waste using reagent water
- Leachable Fluoride of raw, treated, and baghouse dust K088 waste using reagent water at pH 11.5 – 12.5
- CA Waste Extraction Test of raw, treated, and baghouse dust K088 waste (metals)
- Modified CA Waste Extraction Test of raw, treated, and baghouse dust K088 waste (metals)

8.2 Leaching Analysis Protocols

Whether an EPA-approved method or other method is used for the constituent parameter of interest, the laboratory will have documentation of the methods used and any modifications or deviations required to analyze the various samples. If feasible, the laboratory will obtain approval from the EPA Project Manager or his/her designee for method modifications or deviations prior to implementation. Regardless of the specific requirements of the proposed leaching procedures, the laboratory will record the initial and final pH for all leachate analyses. For the purposes of this site sampling effort, the following analytical methods will be used to determine the leachability of the wastes.

8.2.1 TCLP

SW-846 Method 1311 will be followed for TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The resulting leachate will be analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

8.2.2 Modified TCLP

A modification of SW-846 Method 1311 will be followed for Modified TCLP metals leachability testing of the K088 untreated, treated, and baghouse dust waste. In place of the acetate buffer, a 0.1 M EDTA solution at pH 5 will be used as the leaching fluid. The resulting leachate will be analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

8.2.3 CA WET Metals

The California Wet Extraction Test will be performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The resulting leachate will be analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

8.2.4 Modified CA WET Metals

A modified California Wet Extraction Test will be performed for metals leachability testing of the K088 untreated, treated, and baghouse dust waste. The modification will include a 20:1 liquid to solid ratio with an 18 hour leaching period. The resulting leachate will be analyzed for: antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and arsenic.

8.2.5 Leachable Fluoride

The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste will be determined using ASTM D3987. This procedure utilizes reagent water as the leaching media.

8.2.6 Modified Leachable Fluoride

The concentration of leachable fluoride in the K088 untreated, treated, and baghouse dust waste will be determined using a modification of ASTM D3987 in which the leaching fluid is prepared using a NaOH solution at pH 11.5 to 12.5.

8.3 Target Analyte List

The analytes listed in Table 8–1 represent constituents that have been targeted for analysis. Analyses will focus on those constituents because they are expected to be present in the waste. Table 8–2 presents SW–846 Methods and detection limits for metal analyses. Due to nature of the treatment standard development process, a 0.01 mg/L arsenic detection limit is required for all leachate analyses. However, given the potential matrix interferences that are present with the TCLP acetate buffer, a 0.01 mg/L arsenic detection limit may not be possible. Detection limits for the remaining constituents will be based on the laboratory's lowest achievable quantization limit.

A number of analytical procedures will be employed. These procedures include ICP/AA for total arsenic and leachable metals, GC/MS for PAHs, and Ion Chromatography for fluoride.

Table 8–1. Constituents of Concern

Metals	PAH	Miscellaneous
Antimony	Acenaphthene	Cyanide
Barium	Anthracene	Amenable Cyanide
Beryllium	Benz(a)anthracene	Fluoride
Cadmium	Benzo(a)pyrene	pH
Chromium	Benzo(b)fluoranthene	
Lead	Benzo(k)fluoranthene	
Mercury	Benzo(g,h,i)perylene	
Nickel	Chrysene	
Selenium	Dibenzo(a,h)anthracene	
Silver	Fluoranthene	
	Indeno(1,2,3-cd)pyrene	
	Phenanthrene	
	Pyrene	

Table 8–2. Metals

<u>Target Analyte</u>	<u>SW–846 Method</u>	<u>Detection Limits (mg/kg)¹</u>	
		<u>Leachate µg/L</u>	<u>Solid</u>
Antimony	6010B	60	6
Arsenic	6010B/7060A	10	1
Barium	6010B	200	20
Beryllium	6010B	5	0.5
Cadmium	6010B	5	0.5
Chromium	6010B	10	1
Lead	6010B/7421	3	0.3
Mercury	7470/7471	0.5	0.2
Nickel	6010	40	4
Selenium	6010B7740	5	0.5
Silver	6010B	10	2

Notes:

- ¹ The target detection limits provided are for reference purposes. The actual method detection limits are sample-dependent and may vary with sample matrix.

8.4 Required Methodologies

Unless otherwise stated in this SAP, SW-846 analytical methods will be used for all analyses. Unless otherwise specified, all sample matrices will be analyzed without particle size reduction. Table 8-3 outlines (1) specific waste streams identified by site; (2) the number of samples to be collected; (3) preparative and determinative methods to be used; and (4) the appropriate number of QC samples to be analyzed. Any deviation from these procedures must be discussed with and approved by the EPA Work Assignment Manager and the SAIC Work Assignment Manager.

8.4.1 Metals by ICP/AA

Samples submitted for metals analyses will be digested prior to analysis according to the appropriate 3000 series preparative method and analyzed by 6000 (ICP) and/or 7000 (GFAA/Hydride AA/CVAA) series inorganic methods. The metals of interest are listed in Table 8-2.

8.4.2 Total Arsenic

Total arsenic will be determined using a microwave assisted digestion technique (3052) in which hydrofluoric acid is used to completely digest highly siliceous sample materials. Given the safety hazards and the instrumentation limitations with using this acid, if it can be demonstrated that the sample matrices are low in silica content, the laboratory will have the option of using the perchloric acid digestion technique according to Method 3052. However, the silica content of the treated waste is known to range from 10 – 40%, and in this case the laboratory should consider using boric acid to neutralize potential high fluoride digestate concentrations in order to protect quartz instrumentation parts.

8.4.3 Total Acid Soluble Arsenic

Arsenic analyses using the traditional acid digestion (HNO_3) procedures will be identified as “total acid soluble arsenic”. In order to more closely correlate these results to the total arsenic data, the microwave assisted technique (3051) will be employed.

8.4.4 Total and Amenable Cyanide

Analysis of these constituents will be performed according to 9010B distillation followed by colorimetric determination.

8.4.5 Total Fluoride

Standard Methods 4500-F will be employed as a distillation preparation procedure followed by Method 9056 Ion Chromatographic determinative. Due to the high levels of fluoride expected in at least one sample matrix, the laboratory may decide to reduce the sample size suggested for analysis.

8.4.6 pH

The pH of each K088 waste matrix will be determined according to Method 9045C (Soil pH)

8.4.7 Percent Solids

Percent solids can be determined by drying a sample in an oven at 60°C and weighing the residue.

K088 Analytical Requirements

Analysis	Method	Untreated		Treated		Baghouse Dust	
		No. of Analyses	No. of QA/QC Analyses ¹	No. of Analyses	No. of QA/QC Analyses ¹	No. of Analyses	No. of QA/QC Analyses ¹
Total Fluoride	4500-F Std.Met/9056	8	2	8	4	8	2
Total Cyanide	9010B	8	2	8	4	8	2
Total Amenable Cyanide	9010B	8	2	8	4	8	2
Total Arsenic	3052/6010B	8	2	8	4	8	2
Total Acid Soluble Arsenic	3051/6010B	8	2	8	4	8	2
pH	9045C	8	1	8	1	8	1
Leachable Fluoride	ASTM 3987	8	2	8	2	8	2
Modified Leachable Fluoride (pH 11.5 – 12.5 NaOH leaching fluid)	ASTM 3987	8	2	8	2	8	2
TCLP Metals ¹	1311/7470A/7060A/6010B	8	2	8	2	8	2
Modified TCLP Metals ¹ (0.1M EDTA in place of acetate buffer, init pH 5)	1311/7470A/7060A/6010B	8	2	8	2	8	2
BDAT PAHs ²	8270C	3	2	3	2	3	2
CA WET Metals ¹	CA Waste Extraction Test	8	2	8	2	8	2
Modified CA WET Metals ¹ (20:1 L/S, 18 hour shake)	CA Waste Extraction Test	8	2	8	2	8	2

Notes: ¹ At a minimum a duplicate/matrix spike or matrix spike/matrix spike duplicate is required for each waste sample matrix

² List of leachable metals constituents include: Sb, Ba, Be, Cd, Cr, Pb, Hg, Ni, Se, Ag, and As

³ PAH compounds include: Acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

8.5 Field QA/QC Procedures

The following field quality control checks will be employed during field activities to ensure the quality and integrity of the sample collection:

- Equipment blank: An equipment blank(s) will be collected from the sample collection device(s) used for collection of each sample matrix type. The equipment blank(s) will be obtained prior to sample collection and will be analyzed for total fluoride, cyanide, and total arsenic. Analytical data generated from these analyses will be used to assess possible sample contamination from equipment devices.
- Temperature blank: A temperature blank will be included with each cooler of packaged samples. Upon receipt the laboratory will verify and record the internal temperature for each cooler. A temperature blank will determine if the cooler temperature is at the appropriate 4°C.

8.6 Laboratory QA/QC Procedures

The following laboratory internal analytical quality control measures will be employed to ensure the quality of the data:

- Spikes: A matrix spike and matrix spike duplicate analysis (MS/MSD) will be performed for each analytical method and each sample matrix as outlined in Table 8–3. The samples will be spiked to greater than or equal to twice the indigenous concentrations, or to the midpoint of the instrumental calibration range, whichever is greater. Spiking compounds will include the constituents as recommended in each analytical method. The laboratory will be responsible for generating precision and accuracy control limits for MS/MSD analyses, as directed by Section 8.0 of the SW–846 analysis methods.
- Calibration blanks: A calibration blank is an aliquot of reagent water that has been matrix matched to the calibration standards and analyzed after instrument calibration and every ten samples. The calibration blank will not undergo any sample digestion or preparation procedures prior to analysis. This analysis result will help to determine reagent purity, ensure baseline stability, and document method performance.
- Method blanks: A method blank will be carried through the complete sample preparation and analytical procedure and is used to document contamination resulting from the analytical process.

Method blanks will be prepared at a frequency of a minimum of one per batch of samples or every twenty samples, whichever is smaller.

- Surrogates: Surrogate compounds will be spiked into the samples at the concentrations and frequency as described in each analytical method. Surrogates are organic compounds which are similar to the target analytes in chemical composition and behavior in the analytical process, but are not normally found in residual samples. The laboratory will be responsible for developing surrogate recovery acceptance criteria.
- Calibration standards: Calibration standards will be prepared from EPA reference standards or from commercial high-purity materials that have been characterized by the laboratory for interferences. The stability or holding time of the standards will be monitored, and new standards will be prepared whenever stability problems are encountered or holding times are exceeded. Calibration standards will be prepared to cover the required range of calibration and will be used to determine instrument range, detection limit, precision, and drift.
- Internal standards: Internal standards will be used where feasible to monitor the consistency of response factors, relative response times, injection efficiency, instrument drift, etc. The specific procedures for analyzing internal standards will be followed according to each analytical method.
- QC check standards: For the inorganic analytes, a QC check standard will be analyzed with each calibration and following every 10 samples or according to the procedures detailed in each analytical method. The QC check standard recovery will be within ± 10 percent of the true value or be within the limits set in the method.
- System performance check compounds: For GC/MS analyses, system performance check samples will be prepared and analyzed as specified in the appropriate analytical methods.
- Laboratory water purity: Reagent water meeting the specifications for ASTM Type II water will be used for all analyses.

9. CALIBRATION PROCEDURES AND FREQUENCY

Calibration guidelines for analysis are provided below.

9.1 Analysis Equipment

All analytical instrumentation will be calibrated according to the procedures and frequency specified in the applicable SW-846, ASTM, or other analytical method.

10. REFERENCES

United States Environmental Protection Agency. EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations. EPA QA/R-5 (Draft-Final Electronic Version). October 1997.

Best Demonstrated Available Technology (BDAT) Background Document for Quality Control procedures and Methodology. October 23, 1991.

Final Best Demonstrated Available Technology (BDAT) Background Document for Spent Potliners from Primary Aluminum Reduction K088. September 1994.

Appendix J
Ability of Ormet and Reynolds to Meet Proposed
Treatment Standards: Statistical Calculations

Proposed treatment standards for nonwastewater forms of K088 have been developed using Ormet's performance data for three constituents: fluoride (as measured by distilled water extraction), cyanide (total), and cyanide (amenable). Each system generates residuals that would have to meet these standards. Available performance data are available from each system, and these data are evaluated statistically to determine if the process would be expected to meet the standard.

In summary, evaluation of cyanide and fluoride data shows that the Reynolds process generally can not achieve the proposed treatment standards, while the Ormet process generally can achieve the proposed treatment standards.

Reynolds Data

Leachable fluoride

Data for leachable fluoride (using distilled water) are cited in the August 1998 Notice of Data Availability (63 FR 41536, August 4, 1998). This includes a one page data sheet from December 1996 for six samples. These values are as follows:

<u>Sample Number</u>	<u>Fluoride Concentration (distilled water), mg/L</u>
1	543
2	540
3	567
4	567
5	513
6	567

Table J-1 summarizes the statistical analysis of these data. Analysis using the Shapiro-Wilk test indicates the data could be either normal or lognormal (i.e., this is due to the few number of data points, with relatively little variability).

Table J-1. Analysis of Reynolds Data for Leachable Fluoride (using distilled water)

Parameter	Assuming Lognormal Distribution	Assuming Normal Distribution
Mean	6.308	550
Standard Deviation	0.0403	21.8
Quantile corresponding to proposed treatment standard of 2.7 mg/L	<1 st quantile	<1 st quantile

As shown in Table J-1, the logtransformed mean and standard deviation is 6.308 and 0.0403, respectively. The corresponding 1st quantile is 500 mg/L (i.e., based on the above data set, the process would be expected to result in a concentration of 500 mg/L or less only one percent of the time). This is calculated using a $z_{0.99}$ value of 2.326 and an equation of $\exp(1^{\text{st}} \text{ quantile}) = \text{mean} - z_{0.99}(\text{standard deviation})$, where mean and standard deviation refer to the logtransformed data set (P. MacBerthouex and L.C. Brown, Statistics for Environmental Engineers, Lewis Publishers, 1994). Because the proposed treatment standard for fluoride is 2.7 mg/L (using distilled water), the Reynolds process is unlikely to generate a residue with such a fluoride concentration. Identical conclusions are reached whether the data are assumed to be normally or lognormally distributed.

Total cyanide

Similarly, data for six samples analyzed for total cyanide are presented in this 1996 source. These data are as follows:

<u>Sample Number</u>	<u>Cyanide Concentration, mg/kg</u>
1	50
2	50
3	100
4	50
5	150
6	50

Table J-2 summarizes the statistical analysis of these data. Analysis using the Shapario-Wilk test indicates the data are neither normal nor lognormal. Therefore, the data are compared to an empirical distribution.

Table J-2. Analysis of Reynolds Data for Total Cyanide (using six data points)

Statistical Parameter	Empirical Distribution
Range	50 to 150
Percentile corresponding to proposed treatment standard of 1.4 mg/kg	< 1 st percentile

The proposed treatment standard for cyanide of 1.4 mg/kg is much lower than the lowest value in the range (50 mg/kg), indicating that the process would be unlikely to generate a residue with such a low concentration.

Due to the small number of data points, however, additional data were extracted from the record for the January 1997 rule. These are taken from a memorandum from Dennis Brooks (Reynolds) dated May 23, 1997 (item P-97-P33F-S0117), with 21 data points for kiln residue analyzed for total cyanide from November 1996 to April 1997 where the above data were intended to be a subset. These data are as follows:

<u>Sample Number</u>	<u>Cyanide Concentration, mg/kg</u>
1	48.6
2	21.9
3	23.5
4	24.5
5	39.5
6	29.0
7	30.4
8	62.5
9	50.0
10	24.0
11	38.7
12	25.8
13	28.2
14	23.8
15	24.7
16	66.0
17	67.9
18	64.2
19	199
20	56.9
21	37.5

Table J-3 summarizes the statistical analysis of these data. Analysis using the Shapario-Wilk test indicates the data are neither normal nor lognormal. Therefore, the data are compared to an empirical distribution.

Table J-3. Analysis of Reynolds Data for Total Cyanide (using 21 data points)

Statistical Parameter	Empirical Distribution
Range	21.9 to 199
Percentile corresponding to proposed treatment standard of 1.4 mg/kg	< 1 st percentile

The proposed treatment standard for cyanide of 1.4 mg/kg is much lower than the lowest value in the range (22 mg/kg), indicating that the process would be unlikely to generate a residue with such a low concentration.

While analyses of these data indicate that the Reynolds process is unlikely to meet the proposed treatment standards (i.e., 99 percent of the time it would not meet the standard), there is uncertainty because these data are generally from prior to, or during, their change from brown sand to red clay sand. Reynolds may have more recent data showing significantly lower concentrations of cyanide and leachable fluoride in the treated residue.

Ormet Data

The most relevant data from Ormet are from their June 1999 sampling event. Analyses of total cyanide, amenable cyanide, and leachable fluoride are available from four samples. The glass frit residue was analyzed to determine how well it would comply with the proposed treatment standard.

Statistical analysis for total cyanide and amenable cyanide is not possible. None of the samples had detectable levels of cyanide, above 0.5 ppm. (This is below the proposed standards of 1.4 mg/kg for total and amenable cyanide).

Data for leachable fluoride (using distilled water) are as follows:

<u>Sample Number</u>	<u>Fluoride Concentration (distilled water), mg/L</u>
1	1.9
2	2.3
3	1.9
4	2.5

Table J-4 summarizes the statistical analysis of these data. Analysis using the Shapiro-Wilk test indicates the data could be either normal or lognormal (i.e., this is due to the few number of data points, with relatively little variability).

Table J-4. Analysis of Ormet Data for Leachable Fluoride (using distilled water)

Parameter	Assuming Lognormal Distribution	Assuming Normal Distribution
Mean	0.758	2.15
Standard Deviation	0.139	0.3
Percentile corresponding to proposed treatment standard of 2.7 mg/L	95 th quantile	95 th quantile

Using a lognormal transformation of the data for leachable fluoride, the 95th quantile of the data set was found to be equal to the relevant proposed treatment standard. Therefore, glass frit generated from the Ormet process would be expected to meet the fluoride standard in 95 percent of the cases. Similar conclusions are obtained assuming normal distribution of the data. An uncertainty with this analysis is that it is based only on four data points, which are assumed to be representative of the generated glass frit.

Appendix K
October 8, 1999 Memo from Ormet Corporation

October 8, 1999

Mr. John Vierow P.E.
Science Applications International Corporation
11251 Roger Bacon Drive
Reston, VA 20190

Dear Mr. Vierow:

The following information is taken from information to be supplied to EPA Region V as part of a delisting petition. Spent Potliner (SPL) is removed from each pot in the same way by a large jack hammer mounted on a backhoe which breaks the SPL into large pieces up to 24" long x 16" x 12". The SPL is then scooped out of the pots by another backhoe and placed into large boxes (3 boxes per pot, each containing about 7 tons). SPL in these boxes is placed by fork truck with a 360 degree rotating turntable assembly on the forks into a hopper that feeds a device called a breaker/feeder. This device consists of a series of carbide tipped bits on a rotating head that breaks the SPL into a nominal size of 6 inches in one dimension. SPL is then fed by inclined side wall belt conveyor into the entry port of an autogenous mill at a 5 ton per hour rate. This is a rotating mill, 14 feet in diameter x 5 feet wide with lifting vanes. The tumbling action of the material results in a ground product crushed to minus 40 mesh. The mill has a negative air flow system, which causes the product, when ground finely enough, to be swept out of the mill, by the air current into the classification system. An air heater heats the air coming into the system to ensure dryness in the ground product. The system uses a gyrotor air classifier to separate the oversized material from the properly ground material. Oversized material is sent back to the feed end of the mill. The properly ground product is then conveyed to a 350 ton capacity storage tank by pneumatic transporter. In this manner SPL from pots is thoroughly mixed prior to reaching the storage tank. SPL is conveyed by pneumatic transporter from this storage tank into a 2000 cubic foot silo. This silo feeds the batch weigh hopper where correct proportions of SPL, Sand, and Limestone are weighed and conveyed by pneumatic transporter to a blender.

In this glass making facility SPL is a primary ingredient in glass making, along with Sand and Limestone, which because of its physical properties and chemical composition provides reducing and glass forming agents. No adjustment of reagent/amendment compounds is required. The SPL is homogeneous with minimal variability. As described above, the raw material mix consists of a proscribed ratio of Sand, Limestone, and SPL, and the outcome of the vitrification process is

controlled by temperature and time as material flows through the melter system and chemical reactions occur to form glass.

Glass production begins with the preparation of the primary raw material SPL as described above. Sand and Limestone are received in tank trucks and pneumatically conveyed into 2000 cubic foot silos which are connected to the batch weigh hopper by pneumatic transporters. Sand, Limestone, and SPL are combined weigh hopper at a proscribed ratio to form a 200-lb. batch. These raw materials are pneumatically transported to a blender/feeder system. The blender serves as a receiver for the material pneumatically transported from the batch weigh hopper.

Material is dropped from the blender into two pneumatic transporters (a 15 cubic foot transporter feeding a 5 cubic foot transporter) which serve as the feeder for the melter system. The melter system consists of a Counter Rotating Vortex (CRV) Reactor, a Cyclone Melter, and a Separator/Reservoir. The batch material flows at a rate of 4000 lbs/hr into the CRV Reactor which is a refractory lined, carbon steel, water cooled vessel. In the CRV Reactor natural gas and preheated air is ignited and the batch material is heated to temperatures in excess of 2400 degrees F. The water cooling maintains the metal temperature of the vessel below 160 degrees F. During operation the preheated air and natural gas enters the CRV Reactor via tangentially opposed inlet arms. The high inlet velocities and the tangentially opposed flows provide a well stirred upper section for flame stability and efficient batch heating as batch material is injected into the top of the CRV Reactor. The materials begin to melt in the CRV Reactor and flow downward to the Cyclone Melter where melting to glass is completed. Gas dynamics within the Cyclone Melter separate the glass from gases. The Cyclone Melter is a refractory lined, carbon steel, and water cooled vessel also. The high inlet velocity causes a cyclone flow to occur within the melter. The centrifugal forces caused by the gas dynamics throws the molten glass to the walls where glass forming reactions initiated in the CRV Reactor are completed. The molten glass and gas flows from the Cyclone Melter into the Separator/Reservoir. The Separator/Reservoir, a refractory lined insulated carbon steel vessel, completes the separation of the glass from the exhaust gases. Inside the Separator/Reservoir the gas velocities drop dramatically allowing a final separation of glass and gas. The Separator/Reservoir has a glass residence time of one hour to allow for complete desolution of the raw materials into the glass melt as final glass properties are attained through glass chemical reactions controlled by retention time and temperature. The molten glass enters the glass channel portion of the Separator/Reservoir. The temperature of the glass in the glass channel is maintained using a series of gas burners. Molten glass leaves the glass channel by flowing over a weir to the tap hole. The glass tap hole is located in the bottom of the Reservoir through which molten glass flows by gravity down into a water Quench tank. Water in the Quench tank is recirculated and has no discharge. Upon cooling in the Quench tank, the molten glass solidifies

into a granular glass cullet. The glass cullet is removed from the Quench tank by a drag conveyor and deposited in the cullet storage area and is ready for shipment to customers. The exhaust gases are directed, in the Separator/Reservoir, to the base of the recuperator. Exhaust gas passes through the recuperator where natural gas combustion air is preheated. Flue gas leaving the recuperator enters the recuperator plenum, which is a water cooled carbon steel vessel. Flue gas leaves the plenum and passes into an evaporative spray tower, which cools the gases to 450 degrees F. The flue gas then passes into a bag house where particulate is removed. This particulate, essentially Sodium Fluoride, is placed into 500 lbs. sacks. Much of it is recycled into aluminum reduction pots, although at times more is produced than can be used so it is either stored for future use or properly disposed.

The exhaust from the baghouse is then taken into the potroom dry scrubber system (a baghouse air pollution control device using alumina to dry scrub fluoride from aluminum reduction pot exhaust gases) where any gaseous fluoride is removed and additional particulate removal occurs. The material from the dry scrubber system is the fluoride enriched alumina raw material charged into the aluminum reduction pots. The generation of baghouse dust occurs at a rate of approximately one ton per day, compared to a glass production rate of approximately 22 tons per day. Until a better handling method is discovered Ormet will at times send the material off site for disposal. Currently, the only other waste generated would be refractory materials generated during normal maintenance activities.

As stated above, the molten glass is discharged into the Quench tank where water is used to cool the glass. Glass is removed from the Quench tank by a drag chain conveyor. Water is lost as it evaporates from the tank. Make up water is generally supplied by process water supply. Ormet had thought to occasionally discharge water from the Quench tank during maintenance outages and discussed this with OEPA. However, the dissolved oxygen values were not acceptable. If the quench tank requires maintenance and water removal, the water is pumped into a temporary mobile holding tank and reused.

The estimated SPL generation rate of 6000 tons/year would be an upper limit. Our average annual SPL generation rate is between 4600 to 5000 short tons per year. The net annual processing capability of the glass plant based on our operating and maintenance schedule is between 6500 to 7000 short tons per year.

The attached process flow diagram is included for your information. If you need further information, please contact me.

Sincerely,

J.D. Reggi, Director

Corporate Environmental Services

JDR;ds

Enclosure

